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Engineering News-Record

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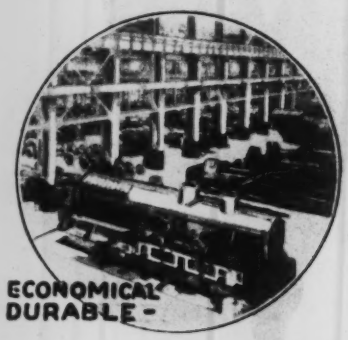

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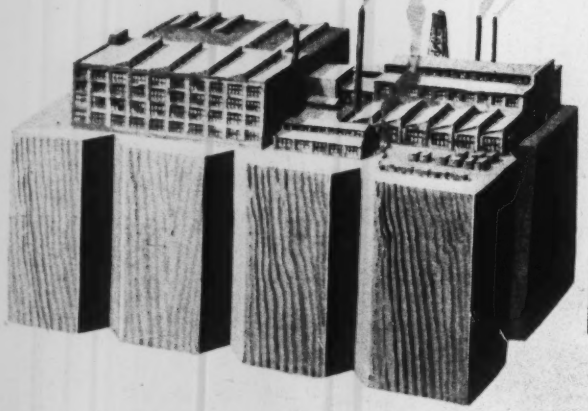

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DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

FRANK C. WIGHT
Editor

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A Point Gained

AS EVERYONE will recall, the essentially vicious feature of Secretary Work's disruption of the Reclamation Service last summer lay in his replacing skilled officials by unskilled political officials. Not only did he deprive the country of efficient, experienced service, but he proceeded by turning over the difficult expert work to untrained hands—the hands of David W. Davis, known chiefly for having helped to lure a fantastic caravan of homeseekers from Brooklyn to its ruin in the Idaho desert, and of his political aid, Miles Cannon. Moreover the replacements were brought about by lawless methods. This is today perhaps less striking, in the light of the fact that Work followed the much-talked-of Albert B. Fall in office; but his flagrant disregard for efficiency principles is as momentous now as it was six months ago. The Cannon appointment in particular came under early attack by the supporters of the civil service doctrine. Secretary Work attempted to have the position exempted from civil service, but his attempt finally failed. It is now announced that an examination to secure an eligible list for the position is to be held shortly by the U. S. Civil Service Commission. Thus we see at last a bit of progress in the fight against delivering reclamation over to the wolves of politics. Six months were required to compel respect for the law in this single item, and the gain made is slight; but it is a gain.

Full-Size Scale Experimentation

ONE of the most persistent of the arguments for a national hydraulic laboratory is that by simulating therein the regimen and topography of a great river there can be settled in a comparatively short time several of the mooted questions of river hydraulics. Among these questions none is more debated than the effect of levees on the elevation of the river bed. Most engineers long experienced in river control contend that levees tend continually to scour out the bottom so that the channel deepens and becomes of greater capacity as the levees become continuous but at the same time they, for the most part, have little confidence in the small scale test as an indication of enormously greater natural manifestations. Evidence in this particular phenomenon on the real river is hard to accumulate, because of the slowness of the change, the effect of numerous contributary influences and the large area over which measurements have to be taken. For that reason the data presented in this issue by Colonel Potter, the head of the Mississippi River Commission, is notable. Here is no miniature river, but the Father of Waters itself, gaged for forty years along a stretch which has been gradually approaching complete leveeing, so that the changing nature of its stream bed may be noted by the average changes of four decades and the tendency of its behavior under levees observed. The results are not startling but they are convincing and certainly more authoritative than would be the results on a tiny stream some hundreds of feet long and a few feet deep artificially arranged to simulate the conditions on the real river.

Sewage-Outlets to Crops

IRRIGATION has been practiced for so many centuries, and so extensively and intensively of late, that the design of irrigation outlets might be supposed to have been standardized long ago. Perhaps it has been in ordinary practice but most irrigation water is carried to the land in open ditches and comparatively little in closed conduits. Even so, it might be thought that pipe distribution systems are now so common in the West as to afford either a standardized design of outlets or at least sufficient experience with a variety of designs to enable an engineer to choose a type of outlet well suited to any new project under his direction. For these reasons Mr. Mitchell's article on another page is doubly interesting: (1) practically and (2) as an illustration of how the engineer adapts means to ends—one of his chief tasks. Beyond this it suggests that there may be more utilization of sewage on land, particularly at institutions where resident labor is available, than is generally understood. Perhaps the practice is one that might well be extended.

Foresight Needed

PENNY wise and pound foolish is well illustrated in the contractor's account of the construction or, better, the completion of the Jim Falls power plant in Wisconsin in this issue. It is particularly significant in this case because it is the contractor and not the engineer who calls especial attention to it. In this case, the matter of time was a controlling feature, and as the largest piece of work on the job was the handling of some 200,000 cu.yd. of material in excavating a headrace canal and building embankments along each side of it, the class of material encountered in excavating the canal was an important item. A rough preliminary study of the land through which the canal was to be excavated did not indicate much rock, but when excavation was actually started so much rock was encountered that it was necessary to reduce the depth and increase the width of the canal in order to avoid moving large quantities of this rock. As a result of this, the work was delayed at a time when the contractor had extensive equipment and a large number of men on the job, and in addition the amount of material to be moved was increased about 30,000 yd. Nearly a month elapsed between the time that negotiations started between the contractor and the company and the time the contract was signed. In this month a small field party with sounding rods and a few laborers could have prepared enough cross-sections of the canal prism to indicate the character of the material to be handled, thus avoiding the expensive delay which occurred months later.

A Policy For Reclamation

MEN of the great West often assert that the future of the nation lies there. They may or may not be right; but at all events vital interests of the country are locked up in the resources of the Plains and the Basin. Each one of us is concerned in the upbuilding of that region, in the development of its agriculture and its water power. Still more are we concerned when the question is involved whether the nation, to further that growth, shall engage in business, and whether sound or unsound principle shall be applied to such business. This question is made an immediately urgent one by recent events in connection with additional land reclamation. Public money to the extent of millions of dollars is involved. But the money is less important than the inevitable consequences of drifting along in the vast enterprise with no policy.

Following on the virtual completion, a few years ago, of the huge program of nationally subsidized irrigation initiated in 1902, it was tacitly agreed that a halt should be made, that for the time being any further investment of public funds in this work was unwise and might constitute a grave threat for the future. Congress has since observed a virtual holiday with respect to new reclamation work. It realized that the enterprise as it stood rested on a twenty-year-old law, of splendidly ideal purpose but faulty in practice; a better policy needed to be wrought out of experience before anything further should be done. But with the present session of Congress strong pressure is being exerted to plunge the country anew into reclamation adventures—in spite of the almost certain prospect of loss on the projects advanced, and in the face of a general effort toward utmost economy in government expenditure. Though the farmers of the Great Plains are still complaining of agricultural overproduction and resultant distress, the country is asked to pour new millions into western irrigation to create more farms.

Neither overproduction nor the excessive cost of the proposed projects is the most serious side of the matter, however. The really ominous feature is that by entering on the new projects the federal government would be forced deeper into the retail irrigation business, in which it is already engaged far too deeply. So today we face the plain question whether the nation shall continue in the irrigation business. And, be it specially noted, the irrigation business today is quite likely to include the power business.

On this broad question there is little doubt of the answer: "No, let the federal government keep out of business." Nevertheless, some may believe that irrigation operation is so special as to be a proper and sound government activity. These people may find enlightenment in a set of resolutions recently voted by representatives of some of Uncle Sam's customers in this business, namely, the water users. These resolutions constitute a claim of voluntary bankruptcy; they ask that a moratorium be declared (on debts to the government alone!), that obligations be canceled, that overdue charges be continued free of interest, that private debts be made superior to government debts, and that gifts be made to them of national property which does not pertain to irrigation. The resolutions reflect neither square business principle nor a sound individual conscience, and if they truly represent the thoughts of the reclamation farmers they indicate that the government business venture has led to the development of qualities hitherto strange to the West and far from desirable.

Or, for another view of what the governmental irrigation business may lead to, let them consider the now pending application of the Farmers Irrigation District, of Nebraska, originally a private enterprise and now conducted by a local government. Representatives of the district are asking the Department of the Interior not only to extend the time for paying charges for water sold them in bulk by the government and already used, but also that they be allowed to discontinue the operation of their own irrigation works and that the government operate them—in order to shift the deficits of their farming operations to the ample national treasury. And, for still another view, we have attitude taken by Secretary of the Interior Work before a committee of Congress recently, when the Secretary, without waiting to learn the facts from the board of advisers which he himself appointed for the purpose, claimed that many reclamation projects have been built at excessive cost and that the payments contracted for by the farmers must be reduced and even the reduced payments deferred—a franker espousal of the cause of the repudiation faction than could have been expected in other than a year of political campaign.

When the government's business operations, though ably and efficiently conducted, lead to such results—that the beneficiaries seek to plead bankruptcy and at the same time ask for gifts, that unsuccessful or inefficient private business tries to unload on the government, and that a government official undertakes to deprive the government of its due—one may readily conclude that the government should not engage more deeply in that business.

A way to improvement is open. It is possible today to formulate a governmental policy of sound participation in the development of land resources, by which healthy development will be promoted without involving the government in business or leading to unhealthy conditions and practices.

Under the Reclamation Act, still in force, it is the declared policy of the country to build irrigation works and create new farms in the arid West as rapidly as demanded, to the extent that money becomes available. Because the nation generously allotted a certain part of its annual income to the arid regions for such work, a belief has arisen that this income as good as belongs to the region, and that so long as this income exists it must be spent, wisely or unwisely. As might readily be foreseen, this belief has had disastrous consequences; and it needs no argument to uphold the principle that an unwise expenditure should not be made. Further, as will be recognized by most, the mere fact that an expenditure is for irrigation development does not make it wise. Other questions determine its wisdom and soundness. If such criteria are applied both to the enterprise as a whole and to the methods by which it is carried through—if we lay down the doctrine that only sound enterprises should be undertaken and that sound methods should be applied to them—it is easily possible, with the help of the record of experience with irrigation and present-day knowledge of the factors bearing on the success of irrigation farming, to work out a sound future policy on which all can agree.

Irrigation does not stand by itself, and the nation is not the only party concerned in its development. The policy therefore cannot take into account federal irriga-

tion alone. Twenty years ago it was believed that the states were not able to take up the burden of irrigation development, but they are now in a far different position; and experience has shown that only a local government is capable of dealing with the local administration of such development. A policy for the future, then, will be not a code of federal action, but one of joint federal and state action. Again, during the twenty years our water-power resources have come to occupy a commanding position in the Western problem, and today reclamation of power has to be considered equally with reclamation of land. Water utilization involves both; but power has a much wider geographical influence than land, and its development must be in the interests of the whole country even much more imperatively that that of land. Power, then, though connected with irrigation, demands to be treated independently and not as a subsidiary. Finally, equitable administration of interstate and international water is involved in all Western problems of either irrigation or power, and must be fully guarded by the national policy, if it is to prove workable.

The salient points of weakness as well as strength of the reclamation system as it has existed were well brought out in the survey of federal reclamation given by the series of articles and letters published in *Engineering News-Record* last year (in the issues of Oct. 4 to Dec. 20, 1923). With them, C. E. Grunsky's important discussion of the government's relation to the water resources of the arid region, in our issue of Jan. 3, 1924, invites consideration. The data furnished by these articles enable the part which the national government is to take in irrigation development to be outlined. In this way, some primary dictates of sound national business doctrine applied to irrigation may be written down, thus:

First, that it is the federal government's duty to work out systematic plans for the conservation of the scanty water resources of the West, and to guide and control the development of these resources accordingly. Storage of flood waters is the most important phase of this planning.

Second, that allotment of water use and actual development are to be controlled by the criterion of most efficient use.

Third, that each development, of land or of power, must pay its way, in order to be sound economically and to breed self-supporting men rather than pensioners.

Fourth, that the federal government refrain from entering commercial or business relations, particularly with private individuals; that to this end it act as the planning and financing agency and go no farther than construction or supervision, leaving the actual administration (operation and taxation) to the local authorities.

Fifth, that the national investment be protected as thoroughly as a bank loan, through proper funding by a strong local authority representing adequate financial security, preferably the state.

Sixth, that, in view of the proved difficulties of starting up farming under irrigation, due care be taken to provide not merely the groundwork of irrigation (the water and the bare land) but such further construction and financing as may be required to make farming a going business, backed by a substantial money investment on the part of the farmer to establish the spirit of partnership effectively.

Seventh, that the national interest in efficient agricultural development of the desert be recognized by providing agricultural aid and control to assure the lasting success of the undertaking.

Eighth, that the government recognize its obligations to the country at large as custodian of power resources as fully as of irrigation resources, but independently thereof.

Ninth, that the planning and control of water resources be so directed as to care for all interstate and international needs, and, in addition, lead toward the evolution of uniform water right and water utilization principles throughout the arid region.

Basing on broad rules of this kind a working policy can be formulated, we believe. It should at all events include specific details of application, however. The non-specific character of the present Reclamation Act has been convicted of responsibility for much of the harm which has been done in its application.

Only one point of this detail calls for notice here. In the present act it is contemplated that each dollar of federal expenditure shall be returned. In its essence, this is an indispensable requirement of sound business. But in so broad a development undertaking as is now under discussion, we believe that the principle will fail of application at some points. Stream storage development, for example, is in the aggregate so great a task that it will often be undertaken (or should be undertaken) before it is possible to make immediate profitable use of all the water, and in the meantime there will be carrying charges. Such charges, if left to accumulate as an initial burden on the use to be made of the water later, would be apt to prove oppressive and impossible, and they should instead be borne by the nation at large as a current expense chargeable to national development. But it would be obviously fatal to extend this principle over into the period when the water is actually utilized, for then the nation would be committed to a bare-faced subsidy to a business. We may subsidize conservation, but we may not subsidize a business built on that conservation.

Such detail needs to be laid down in the basic act. If the law fails to specify the fundamental doctrines of the repayment as does the existing act, it will lead inevitably to the same political evils that marked the past.

In the same spirit, the extent to which flood protection measures and other river control are a proper national charge ought to be determined as a matter of general policy in the basic act. If left for decision in the individual case, the conflicting claims of local beneficiaries and of the nation will surely lead to dissatisfaction, political intrigue, and bitterness. Such results may be avoided by drafting the policy in sufficient detail at the beginning. Thus detailed, a new reclamation act will constitute a secure foundation for the work of a period of development, which, we believe, will be far more striking and significant than that of the past two decades.

An able group of men is just now studying the achievements of reclamation in the twenty-year period and how the practice should be improved. We sincerely hope that this board will extend its work sufficiently to formulate and present a fully detailed national policy for guiding the future utilization of Western water resources; and we hope, moreover, that this may be done soon. Until such new policy is at hand, and is adopted by Congress, it is our firm conviction that any further expenditure for irrigation development under the Reclamation Act is unwise.

Completing the Jim Falls Hydro-Electric Development

Time Element a Controlling Feature—Method of Combating Northern Winter Conditions—Importance of Careful Preliminary Studies

By A. J. Hammond
Chief Engineer, James O. Heyworth, Chicago, Ill.

THE CONSTRUCTION of the Chippewa Power Co.'s Jim Falls hydro-electric plant on the Chippewa River in Wisconsin is of interest as showing how, with a proper organization and construction equipment, such work can be carried on successfully throughout a northern winter. The development of this site was started a number of years ago, but was abandoned after the masonry work of the dam had been completed. The entire project consists of a low dam across the river at the head of Jim Falls, a headrace canal 4,500 ft. long with control gates, an intake structure with surge spillway, three 14-ft. steel penstocks, and a concrete and brick power house containing three 6,000-kva. generators. Provision has also been made for an additional penstock and 6,000-kva. unit.

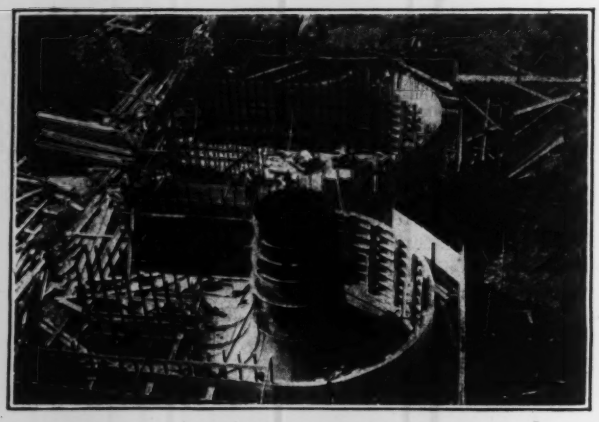


FIG. 1—SETTING ONE OF THE HYDRAUCONES

The dam consists of a west embankment 430 ft. long with a concrete core wall, a 209-ft. solid concrete spillway with timber flashboards about 4 ft. high, which are intended to break down automatically under the increased pressure of the water at the times of flood, and a controlled spillway section consisting of sixteen tainter gates, 16 ft. wide and 13 ft. deep. Beyond the east end of this spillway there is another earth embankment with concrete core wall 1,130 ft. long extending over to the control works of the headrace canal which consists of forty-two gate openings 8 ft. wide and 8 ft. deep. These openings are not provided with gates, but only with stop logs as they are for emergency use.

The original design of the dam called for sixteen tainter gates 16 ft. long and 8 ft. high. The modified plan retained the tainter gates but raised the level of the pond 5 ft. by increasing their depth to 13 ft. and raising the level of the intermediate buttresses. As the pinions for the gates had been set in the original concrete, they were retained in the modified design, although they are lower than it is desirable to have them on account of the possibility of their being damaged by ice during the spring freshet. Usually about 3 ft. of ice forms above the dam, and last year it had to be blasted to get it through the gates.

The old gate sill was of wood and in the reconstruction it was taken out and a concrete sill was made in the trough, into which the gate was set while concrete was fresh. The skinplate of ¼-in. steel plates was bent around and under an 8-in. channel and riveted with countersunk rivets to the bottom channel before the impression was made in the concrete sill.

At the sides of the gate five-ply rubber belting was bolted to the gate to make the edges watertight. The gates were first lowered in place by a gantry frame, and are now raised and lowered by means of an electric hoist running on a track along the dam.

Four of the gates on the downstream face are provided with a wooden frame enclosure, and electric heating elements are installed along the gate edges to melt ice and permit immediate operation of these gates in case of a winter flood. The spring floods are about 30,000 to 40,000 sec.-ft.

At the time of the original construction the core wall for the earth fill dam between the spillway section and the headgates of the headrace canal was built, but no filling was placed, and the concrete control works for the canal were also built but no excavation was started.

Contractor's Operations—Negotiations between the power company and the contractor began early in June, 1922, and on June 30 a contract was signed which called for the plant to be ready for operation on Dec. 31, 1922, just six months from the date of signing. The contractor's estimate of progress was based on "no rock excavation" and the delivery of the hydro-electric machinery according to schedule. The contractor had found by previous experience that small units of messhall, kitchen and bunk houses set up in sections to accommodate from sixteen to twenty men best suit the requirements of a growing job. He moved on the site immediately and started working on this basis so that by July 15 he had accommodations for housing and feeding 300 men all in shape and 200 men on the job. He also had his own tool and supply cars moved to the

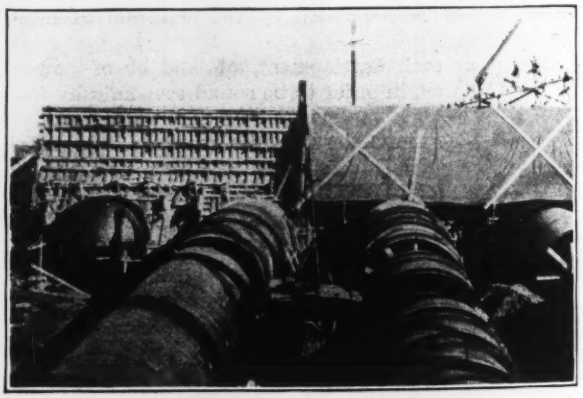


FIG. 2—PENSTOCKS AND INTAKE STRUCTURE
Portable air compressor between the penstocks. Note the method of bracing penstocks to maintain true circular section until stiffeners are riveted.

job and two locomotive cranes for unloading and erecting plant; in all, $100,000 worth of contractor's plant in operation 15 days after the contract was signed.

The largest items in the contract for the completion of the project were 246,000 cu.yd. of excavation and 185,000 cu.yd. of filling, of which 177,000 cu.yd. of excavation and 164,000 cu.yd. of filling were in the headrace canal. This work was the controlling feature.

Headrace Canal—As the whole site was covered with dense brush and was cut up with granite ledges and intervening mucky spots, it was difficult to tell beforehand what was the character of the material which had to be excavated from the headrace canal. The original plan calls for a channel width of 75 ft., but after excavation had started it was found that considerable solid rock in the form of ledges would have to be excavated if the canal was continued at the width and depth of the original plan. Consequently, the width of the north end of the canal, the end where this rock occurred, was increased to 150 ft. and the depth was reduced correspondingly. The delay caused by this lack of proper preliminary investigation was costly both in time and money because the contractor's equipment and men were already on the ground.

Such material from the canal prism as was available for sluicing into the canal embankment was used there. The remainder of the embankment material, obtained by borrowing in the neighborhood, was sluiced into place and puddled. As most of the material for the lower end of the canal came from the excavation of the upper end, it was necessary to construct a trestle 1,500 ft. long to handle this material. The trestle bents were of four piles each, with sills and caps, spaced 32 ft. on centers, using four 10x20-in. stringers.

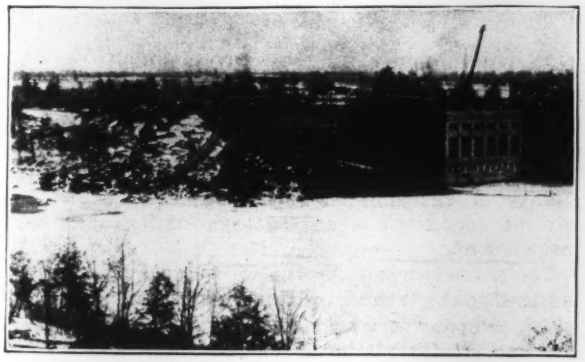


FIG. 3—INTAKE, POWER HOUSE AND SURGE SPILLWAY
Earth has since been backfilled over the penstocks and against the sides of the spillway channel.

Between July 2 and Oct. 6, about 200,000 cu.yd. of material, including a large amount of granite from ledges, was handled in the canal excavation and filling. An analysis of the headrace canal excavation and embankment comparing the estimated figures with the actual figures is of interest. The original figures are:

75,635 cu.yd. direct disposal by drags
84,365 cu.yd. car disposal by drags
1,500 cu.yd. stripping or muck disposal by drags

The actual work caused by rock and unusual muck conditions was as follows:

75,944 cu.yd. direct disposal by drags
90,642 cu.yd. car disposal by drags
25,584 cu.yd. stripping or muck disposal by drags

The excavating equipment consisted of two dragline excavators, one small and one large steam shovel, a 36-in.-gage steam locomotive and cars of 4-cu.yd. capacity, and 24-in.-gage track with gas locomotives and cars of 1-cu.yd. capacity. The sluicing equipment consisted of a 4-in. direct-connected centrifugal pump rated at 600 gal. per minute under a 250-ft. head, with a 6-in. feed and 4-in. discharge pipe.

FIG. 5—AIRPLANE VIEW OF JIM FALLS PLANT

The construction of the headrace canal required the regrading of a considerable portion of the highway, the construction of a 240-ft. steel highway bridge and the relocation of approximately 2 miles of the Chicago, St. Paul, Minneapolis & Omaha Ry., involving 58,000 cu.yd. of grading with considerable right-of-way clearings.

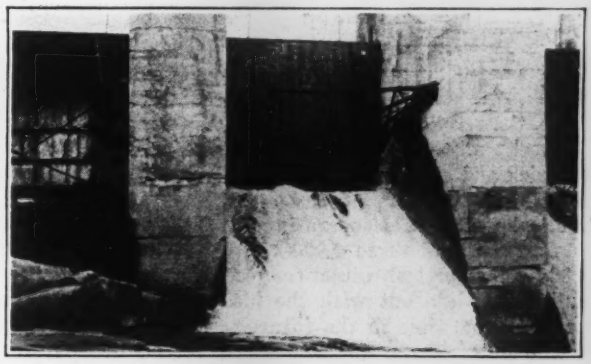


FIG. 4—TAINTER GATES IN THE MAIN DAM
Showing method of protecting four gates so that they can be heated for winter operation

Intake Works—The headrace canal terminates in a reinforced-concrete intake structure, 178 ft. back of the power house, which contains the gates and screens for the four penstocks, and supports a steel framework carrying the block and fall arrangement by which the four gates are operated. At the right of this structure is a surge spillway 40 ft. wide with a concrete lined channel extending down to the river's edge 40 ft. wide at the upper end but narrowed down to 20 ft. for the greater part of its length. The intake has four openings 14 ft. 6 in. square, with gates and screens for four penstocks, but only three have been built. These three penstocks are 14 ft. in diameter, of $\frac{3}{8}$-in. steel plates

reinforced with angle ribs at 2 ft. 6½ in. intervals. These steel plates were delivered in curved sections and were matched, drilled, riveted and calked on the job, and the rib stiffeners were riveted on the pipe as it was erected. One portable and one stationary air compressing plant were used for this work, and a 50-ton stiff-leg derrick with an 80-ft. boom was used for setting the sections of the penstock in place. After the penstocks had been painted and tested, they were covered over with earth to a minimum depth of 2 ft. above the top of the pipe.

Power House—The concrete mixing plant for the power house and the intake was located under the service trestle at the top of the bank near the power house. The concrete was handled from the mixer to the power house and intake in the skip of a stiff-leg derrick situated between the two structures.

The power house is situated in the rock ledge on the bank of the river. The foundations are of mass concrete, the scroll-case and draft tubes of the turbines are of steel, and the superstructure, which is 82x106 ft., is of brick and steel with a cement tile roof. The present installation consists of three 4,800-hp. propeller type vertical waterwheels operating at 138½ r.p.m. under a 50-ft. head, and three 6,000-kva., 60-cycle, three-phase, 2,300-volt, vertical direct-connected generators. The building is laid out with the idea of adding a fourth unit at some time in the future.

The entire hydraulic and electrical equipment was furnished by the Allis-Chalmers Manufacturing Co., but was installed by the general contractor.

The superstructure of the power house was built during very severe winter weather and although all the materials were heated and the bricklayers' scaffold was inclosed in canvas and heated with salamanders, one of the walls froze and then later on one very bright day the sun thawed the mortar in one face of the wall and the shrinkage threw the wall badly out of plumb. This condition was rectified by covering the opposite side of the wall with canvas, heating the space between the canvas and the wall by means of salamanders and then drawing the wall back into position.

The tailrace channel was deepened by excavating under water with a dragline of 1-yd. capacity. Two deadmen were buried in the river with a bridle between them and the scraper was handled by means of an endless cable operated by a hoisting engine on shore. About one-half the material taken out was granite ledges, part of which could be dragged loose but part had to be blasted loose by driving pipes into crevices and setting off dynamite charges in the lower end of the pipes.

Time Occupied in Construction—In work of this character in northern Wisconsin long experience has demonstrated that between March and January one day of the working season is worth three days between January and March. On this basis of figuring the time occupied on the work was as follows: Contract signed, June 30, 1922; camp and equipment installed July 10-18, and working days to Dec. 31, about 125 days, plus one-third of the days in January, February, and March or 28 days, making a total of 153 days, or practically six months. The first generator was put into operation on April 11, 1923, and the last one, the third, on April 23, so that despite the car and coal shortage and the lack of skilled labor for the power house work during severe weather the job was finished in practically six months of normal working time. This job holds the record for one of this character and size in the contractor's twenty-one years of experience and shows the possibility of carrying on such work even under very adverse conditions when the organization and equipment are of the proper character.

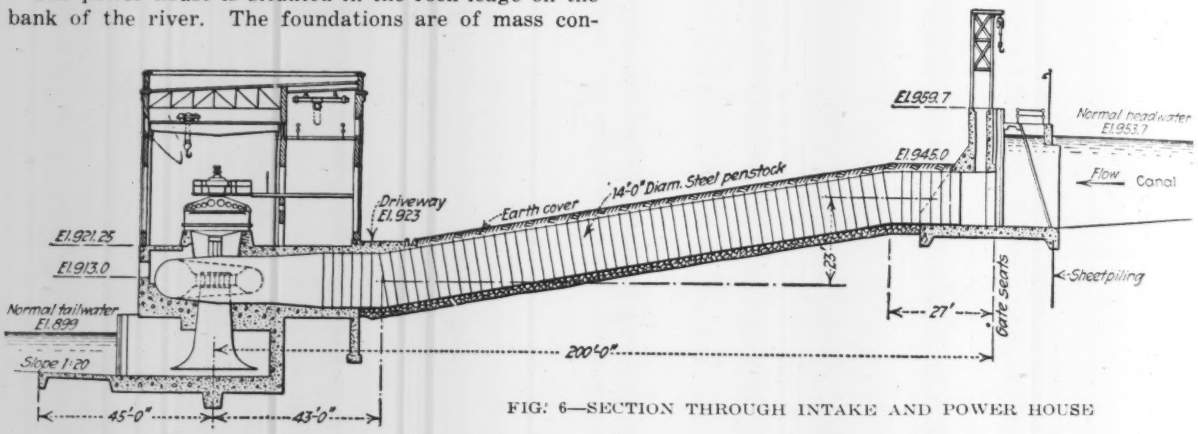


FIG. 6—SECTION THROUGH INTAKE AND POWER HOUSE

The plant is owned by the Chippewa Power Co. and is leased to the Wisconsin-Minnesota Light & Power Co., which company is a subsidiary of the Northern States Power Co. The latter company is operated by the Byllesby Engineering & Management Corp. James O. Heyworth, engineer and general contractor, of Chicago, Ill., with whom the writer is associated, was the general contractor.

Elevated Railway for Calcutta

Local or rapid transit railway communication across the city of Calcutta, India, is to be provided by the construction of an elevated line from the present terminal at Sealdah, on the east side, to Dalhousie Square on the west side. A future extension of this line westward across the Hooghly River to the railway terminals at Howrah will be made when the proposed new Hooghly bridge is built. The elevated structure will be a masonry arch viaduct, revenue being obtained by leasing the spaces beneath the arches for storage purposes. This project, worked out by A. H. Johnstone, chief engineer of the East Indian Ry., has been approved by the Housing and Communication Committee of the city of Calcutta.

Engineering and Construction In Paris: Plans and Progress

From Our Paris Correspondent

OWING largely to the stagnation in building during the war, added to the natural expansion of large cities, Paris, during the past two years, has seen a more considerable activity in construction work than in ten years previous. The sole failure to meet construction needs is that not enough dwellings are going up to care for the surplus population, which is being crowded into certain districts by the encroachment of big and little business.

Without considering merely projected works, those actually under way are of sufficient moment to attract the attention of all as being of first importance and magnitude in their respective classes.

Completion of the Boulevard Haussmann—The great reconstructor, or maker, of modern Paris was Baron Haussmann, who operated under the ambitious Napoleon III. The great boulevard which today bears his name, begun more than half a century ago, is only just achieving its completion. The expropriation régime has now entered upon its final stage and the old buildings of the Rue Taitbout and the Rue Lepeletier are being demolished so that the boulevard may have a clear right-of-way through to the Boulevard des Italiens, actually cutting through one of the most luxurious and most valuable business quarters of the capital. The distance is approximately an eighth of a mile and the work had been hung up for a quarter of a century.

Demolishing of the Fortifications—The demolishing of the fortifications—the third of the sequence of historic walls which have sealed up Paris for centuries, retarded its growth and been a useless and ineffectual expense—has already begun, ultimately to be carried out through the entire periphery of the city. Nineteen bastions of the fortifications have already fallen before picks and shovels. As soon as the ground is cleared there will be a free area, practically an eighth of a mile wide and entirely surrounding Paris, available for building purposes or for a new encircling boulevard system. The latter would be preferable for Paris is greatly in need of park spaces, though the housing question is most pressing. In any case it is an important civic improvement, undertaken only after a world war proved that stone fortification walls were something that went out when airplanes came in. The area thus reclaimed will be the equal of a 750-ft. band twenty-eight miles long.

The Port of Paris—The "Port of Paris" project conceived by the first Napoleon is something which one day is to come into its own by straightening certain down-river serpentinings of the Seine, thus making the sea accessible by a short water route. Even now small steamers ply between Paris and London. The Port of Paris project as such today means simply that a coordinated series of ports and docks will be established between the junction of the Seine and the Marne just above the east fortifications on the banks of the river below Saint Denis, including also the Canal de l'Ourcq and others.

This project is divided into four groups, the first and second comprising the amelioration and immediate local extension of the municipal harbor and the river harbors and wharves distributed along the banks immediately above and below the center of the city. The third group unites these projects, making use of a part of the land freed by the demolition of the fortifications, and the establishment of basins or land-surrounded docks (similar to those so frequently in use in England) debouching in the Seine or the lateral or contributary canals. The fourth group is to comprise the great exterior ports, those outside Paris proper but within its sphere of influence.

In the first group the locks of the Saint Denis Canal are actually being lengthened to 62.5 metres, a needed and appreciable improvement and one which, because of its small cost, will give an almost immediate dividend by reason of the intensive canal boat and barge traffic with the La Villette Basin of the Paris abbatoirs. A special form of propulsion for canal boats is being installed.

A more important project is the construction of a port at Pantin which, by national government decree, will shortly be recognized as of public utility and will thus be susceptible of receiving national aid if required. The Saint Denis canal will here be locally enlarged into a port with a sufficient capacity to handle 1,500,000 metric tons per annum. The expense of the foundations and quays, not including warehouses and accessory sidings, etc., will exceed 6,000,000 francs, to which must be added expropriation expenses.

Among the projects of the second group is the execution of the Port Rapée-Bercy, a project which has been held up for many years and which is intended to handle most of the vast wine traffic of the capital which today is exceedingly hampered and confined.

The chief of the great exterior ports will be that of the Plain of Gennevilliers, in a tongue of land below Paris, opposite Saint Denis, where is situated the most important central station supplying electric light and power to the Paris district, and which is ultimately to be linked up with the powerful Orleans Ry. electric plant as a safeguard. An extensive community of small manufactures is expected to build itself up on this tongue of land and the port will thus of necessity become of great importance. This port with its basins and its open and covered storage space will be a thousand acres in extent and will cost approximately 146,000,000 francs.

New Bridge Across the Seine—The new Tournelle bridge has yet to be let as a construction project. At the moment the old temporary structure is completely demolished with the exception of the central pier which is to be retained as an anchorage for the new arch during the period of its construction. This new bridge will be what the French call an "ouvrage d'art," a heavy masonry bridge following the best classic traditions of the French builder and in the end will form an important artery of traffic between the right and left banks of the Seine in an exceedingly busy quarter. (See *Engineering News-Record*, Sept. 27, p. 511.)

City Bonds for Construction Needs—A municipal bond issue was authorized in 1921 for 1,800,000,000 francs on behalf of municipal improvements yet to be undertaken, of which sum 576,000,000 francs were to be available for work which would be under way in 1923. The enumeration of these additional works in their entirety is not possible here save to state that they comprise appropriations for new streets, public buildings, police and fire barracks, parks, hospitals, working-

men's dwellings (on which a new municipal experiment is to be made) and cemeteries.

Additional Water Supply—An additional water supply for the left bank of Paris is being undertaken by bringing in the waters of the tiny river La Voulzie to the south of the city. There are being laid 62 km. of cast-iron pipe of a diameter of 1.25 m., manufactured by the famous Pont-a-Mousson foundry which was occupied by the A.E.F. during their Argonne advance, an establishment which claims to have already arrived at 85 per cent of its prewar output. Thirty kilometres of this pipe is already laid and another year is estimated as being required for putting in the rest. During the same period there will be completed two pumping stations at Ormes and Longueville, and the two reinforced-concrete conduits to the city. During the summer of 1924 Paris will thus be supplied with an additional 100,000 cu.m. of water per 24 hours. The cost of the entire work approaches 66,000,000 francs.

Miscellaneous—In addition to the work specifically outlined various other undertakings of a greater or a lesser magnitude tend to show a sum total of work under way which will run to several hundred millions of francs, including two new loops on the subway which the company in conjunction with the municipality is completing.

Not included herein are any of the various housing schemes in which the county, municipality or individual organizations or associations are interested, the remodelling of the Saint Lazare Ry. station or the demolishing of the dangerous Batignolles tunnel, leading thereto.

Bridge Floorbeam Shears Off Under Load

Truck Drops With Two Floor Panels of Bridge at Pittsburgh—Web of Floorbeam Damaged by Corrosion

By Edward Godfrey
Structural Engineer, Pittsburgh, Pa.

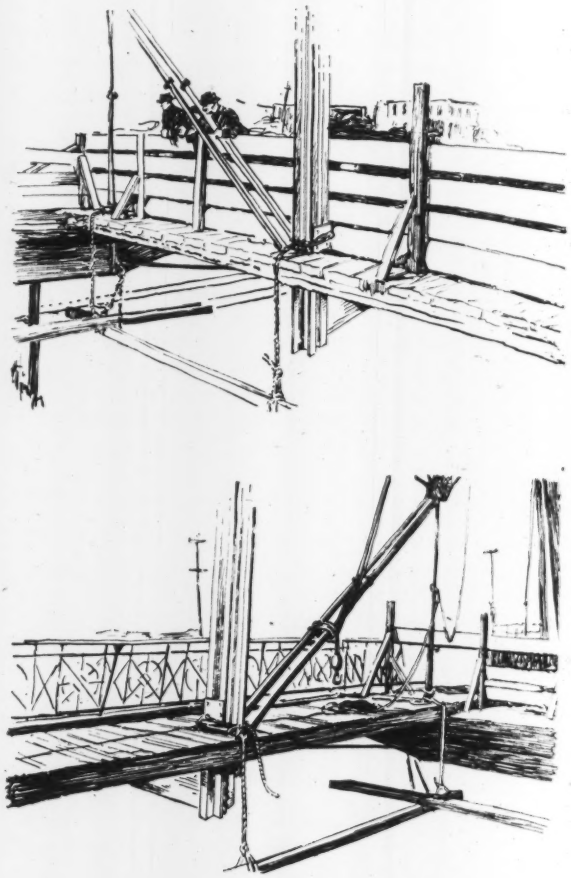
On JAN. 18 an unusual accident occurred on the Herr's Island bridge over the Allegheny River in Pittsburgh. A truck loaded with hogs was being driven from the stockyard to the north side, when, without prior warning, a floorbeam of the bridge suddenly dropped and precipitated two panels of the floor together with the truck and its load into the waters of the back channel. The truck was completely submerged and one of two men was drowned.

The bridge is a pin-connected truss span. Some of the verticals are Z-bar posts, and the web plates of the floorbeams pass through the posts, being riveted between the Z-bars. At the place where the floorbeam failed, the right-hand end of the floorbeam (as seen looking in the direction in which the truck was moving) sheared off in a vertical line where it penetrated the Z-bar posts. The break does not show any clear metal but is all rusty. On the other side of the bridge, the post was ripped at the top line of the floorbeam, and the web sheared in the middle line of the Z-bar post. The gross weight of the truck which broke through is stated as about 26,000 lb., the vehicle itself weighing 14,000 lb. and the load 12,000.

The roadway floor is of wood block and the sidewalks of wood planking. The wood is laid up close to the steelwork, with no space for ventilation, inspection, or painting. This is a fruitful source of trouble. Some years ago a bridge in Johnstown failed because of the effect due to wood fitted close up against the steel (*Engineering News*, March 30, 1916, p. 622). Only the short distance of fall prevented a great disaster, for a line of loaded street-cars was dropped into the stream.

In addition, however, the Herr's Island bridge presented another dangerous feature. The drainage from the floor, laden with manure water, doubtless trickled down the side of the Z-bar post from the floorbeam flange, just in the corner where the floorbeam web meets the post. It is apparently because of this condition that the floorbeam web was rusted away just at the point of greatest shear. I have many times found that where water trickles down a definite line a groove is formed; this often occurs in the web of a beam or a tank sheet.

Corners between floorbeams and posts are one of the points requiring special care in the examination of an old bridge, and more than once I have found extreme weakness at this point.



WHERE THE FLOORBEAM DROPPED OUT

Above: floorbeam on loaded side of bridge sheared off where web passed between Z-bars of posts. Below: post on unloaded side torn by fall of floorbeams.

Santa Fé Railway Builds Low-Grade Line in Kansas

New Route Permits Increased Train Loads—Diversion at Eldorado—Construction Methods in Earthwork, Concreting and Structures—Large Water Service Reservoir—Concrete Block Bunk Houses

INCREASED traffic capacity and improved operating conditions, rather than development of traffic in new territory, are the main purposes of the 50-mile direct line between Ellinor and Eldorado, Kan., which is now being built by the Atchison, Topeka & Santa Fé Ry. Thus the new line with reduced grades will shorten the distance and permit a material increase in train loads for through traffic now handled over a less favorable route, but it will also secure some local traffic from an agricultural district which is at present thinly settled and has only a few small towns. Views of some of the works are shown in Figs. 1 and 2. The relation of this new line to existing railways is shown in Fig. 3.

FIG. 1—ROCK CUT WITH MAIN TRACK AT LEFT AND CONSTRUCTION TRACK AT RIGHT

Through westbound freight traffic for the Gulf Lines and Coast Lines of the A., T. & S. F. Ry. System now leaves the double-track main line at Florence, Kan., 157 miles west of Kansas City, and is handled on a single-track line to Eldorado, thence over a short stretch of double track to Augusta, whence the Gulf traffic continues south while the Coast business diverges southwest over the Panhandle low-grade line which again joins the main line near Belen, N. M. Most of the passenger trains use the old route by way of LaJunta, Colo., crossing the Raton and Glorieta mountains. As the single-track line from Florence to Eldorado cannot handle the present business without excessive delays, which unduly increase the operating costs, it was necessary to provide another main track from the main line to Eldorado.

In studying alternatives to double-tracking and improving the original line it was found that a route leaving the main line at Ellinor, 31.5 miles east of Florence, would shorten the distance to Eldorado by 13.85 miles, and give a maximum grade of 0.4 per cent as compared with 0.6 per cent on the present route. This new line will handle approximately 12,000,000 tons per year which now pass over the present line, and the annual saving in operating cost due to reduction in distance and grade is estimated at about $300,000. It will carry all the through westbound business and practically all of the eastbound, any surplus of the latter being routed over the old line, which has no adverse ruling grades from Eldorado to Florence. A second track will be laid on the new line when additional business justifies its construction.

On the operating division between Augusta and Emporia, the train rating over the present line is 3,395 tons in both directions, while on the new line this rating, for the same engines of the 2:8:2 type, will be 4,090 tons. Traffic averages twenty-three trains daily, including both directions. An important but secondary benefit of the new line is in relieving the situation at Eldorado, where the main line runs down one of the principal streets and has a grade crossing of the Missouri Pacific Ry. near the center of the city. This use of the street, especially by long freight trains, interferes considerably with pedestrian and vehicle communication in a city of 15,000 population. As shown by Fig. 3, the new line is located around the east side, with an overhead crossing of the Missouri Pacific Ry., so that through freight trains will pass around the city.

Physical Characteristics—The distance from Ellinor to Eldorado is 48.8 miles, including 6.8 miles of the present Bazar Branch of the A., T. & S. F. Ry., which is to be rehabilitated. The new east side diversion at Eldorado is 1.8 miles, making a total of 50.6 miles. In addition there will be 9.4 miles of sidetracks. The total ascent is 423 ft. and total descent 295 ft., making a rise and fall of 718 ft. as compared with 818 ft. on the old line. In both directions the maximum grade is 0.4 per cent, with 14.24 miles of this grade against westbound and 9.70 miles against eastbound movements. The longest continuous stretch of maximum grade is 12.14 miles. With a total curvature of 706 deg., the sharpest curve is 3 deg. as against 665 deg. total and 5 deg. maximum on the old line. Only 6.94 miles of the main line are on curves. The line is in rolling country and crosses only two large streams, the Cottonwood and Walnut rivers.

Grading—The new railway is being built as a first-class main line. Roadbed width in cuts is 28 ft. between side ditches in earth, 26 ft. in loose rock and 24 ft. in solid rock, with side slopes of 1 on 1, 1 on ½ and 1 on ¼ respectively. Embankments are made with 20-ft. roadbed, which is widened to 24 ft. at ends of bridges. Grading amounts to about 2,927,000 cu.yd. or approximately 57,800 cu.yd. per mile. This includes estimated quantities of 436,000 cu.yd. of earth excavation, 71,000 cu.yd. loose rock, 320,000 cu.yd. solid rock and 2,100,000 cu.yd. of embankment. At some points, owing to the length of haul, the contractors found it cheaper to dump the excavation as spoil and to take material for fills from adjacent borrow pits. The largest cut is a rock cut of 100,000 cu.yd. at Mile 26, with a maximum depth of 30 to 40 ft. The largest fill is of 352,000 cu.yd. at Miles 47-48, with a length of 8,900 ft. and a maximum depth of 40 ft. This is for double track.

In the Walnut River bottom, for five miles north from Eldorado, the soil is sandy loam, with black and red clay where higher ground is touched, and with some hard shale. Thence for more than twenty miles there is rolling prairie country where the material borrowed for fills is mainly black soil underlaid with clay. The cuts were about 50 per cent black top soil and the remainder shale rock. Then for nine miles the fills were made mainly with material from steam-shovel cuts, except when unclassified material could be borrowed for the base of fills. Beyond this stretch the line crosses Crocker Creek (see Fig. 5) with a fill of about 150,000 cu.yd. and then continues to Ellinor in the black adobe soil of the Cottonwood River bottoms.

Rock in the first twenty-five miles from Eldorado is mostly hard shale, beyond which it is flint and limestone with intermediate strata of shale. One of these cuts is shown in Fig. 1. The rock was so stratified as to require very heavy blasting. Compressed air rock drills were used in the shale on the southern part of the line, while in the harder rock 4½-in. blast holes were sunk to depths of 30 to 40 ft. by well-drill rigs.

Earthwork Practice—As an allowance for shrinkage an excess of 7 per cent material was required for earth fills made with fresno and wheeled scrapers, and 10 per cent for those made by dumping from cars. This excess was placed both on the top and sides, thus blanketing the fill. On lighter work the haul ranged from 500 to 8,000 ft. For team work, the free haul limit was 1,000 ft., with no overhaul. On steam-shovel work the haul averaged four miles with a maximum of nine miles, the free haul limit being two miles. Earthwork quantities on steam-shovel work were determined by actual measurements, taking the center of mass of each fill and of that part of the cut from which the fill was made.

Both steam shovels and dragline machines were used for the heavier earth excavation, with elevating graders and fresno scrapers for the lighter work. The graders were hauled by caterpillar tractors and were served by dump wagons and teams. Dragline excavators made cuts only and did no borrow work. They loaded wagons where the material was to be used in fills but on most of their work the material was placed in spoil banks. The steam shovels loaded 4-yd. narrow-gage dump cars, 10-car trains being hauled by small steam locomotives to the dumping trestles. Small narrow-gage spreader cars were used to level the fills. For a large classified cut of 100,000 cu.yd., which was the last piece of excavation, the steam shovel loaded 20-yd. standard-gage air-dump cars, this material being used to finish the Crocker Creek fill, the base of which was made from borrow (see Fig. 5).

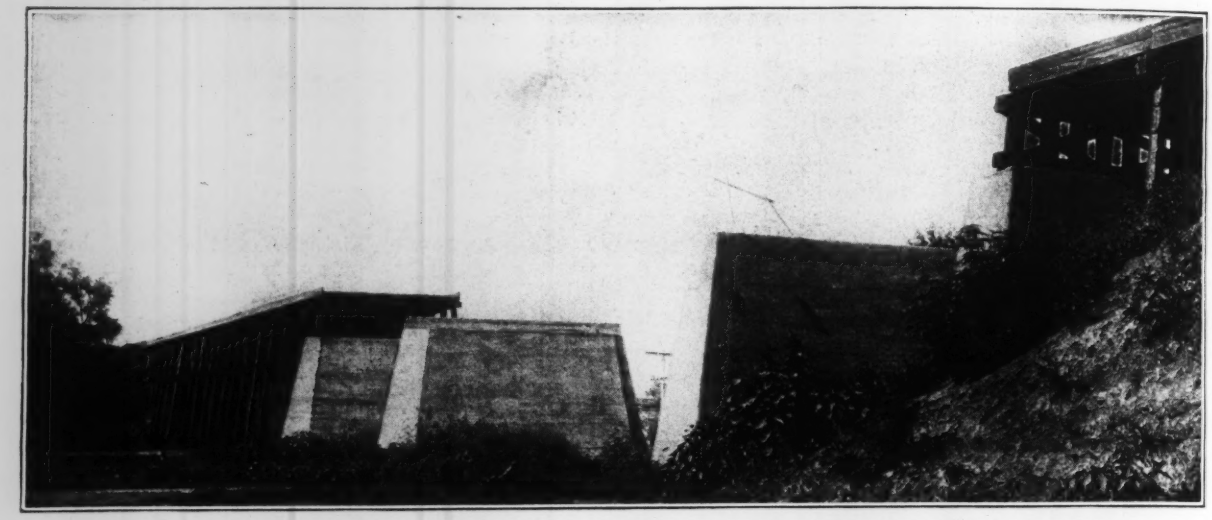


FIG. 2—CONCRETE PIERS AND PILE TRESTLE APPROACHES FOR WALNUT RIVER CROSSING

Difficulty was experienced in making a 500,000-yd. fill east of Eldorado, which averaged 40 ft. in height and was interrupted by three river crossings, five street subways and one overhead crossing of the Missouri Pacific Ry. Since the fill was thus divided into short sections the final runways had to be filled by hauling material onto the top of each section and spreading or bulldozing it over to fill the runways. On rock fills, the top was finished with about a foot of fine material to form an even surface and no large boulders were allowed within a foot of subgrade.

Bridges, Culverts and Trestles—No important bridges are required, the largest having two 100-ft. girder spans over the Walnut River (Fig. 2). Girders are handled by the railway forces, using a special erecting crane which can pick up a 100-ft., 40-ton girder and place it without the use of falsework. Bridges are

designed for the Cooper E-65 loading. Most of these are permanent structures, but pile trestle approaches are used for bridges over the larger streams, as in Fig. 2. Seven creosoted pile trestles were built at crossings where long haul would have been required for concrete materials, but when renewal is necessary these are to be replaced with permanent structures. Typical structures are shown in Figs. 4 and 5.

Plain concrete is used for bridge piers, abutments and arches, with reinforced concrete for box culverts.

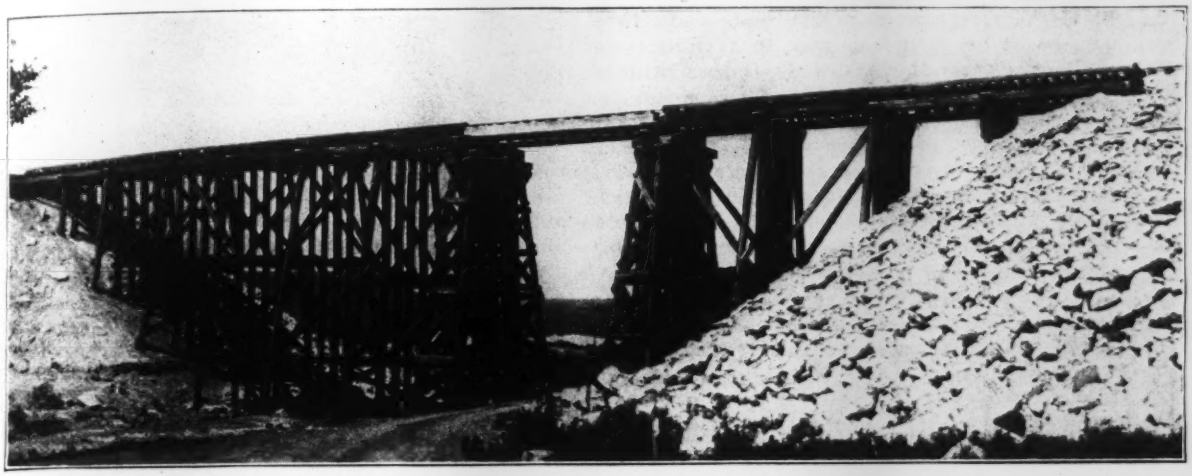


FIG. 4—CREOSOTED PILE TRESTLE WITH BRACED PIERS AT JACK CREEK

Creosoted wood boxes carry the roadbed side drains under highway crossing approaches. Ordinary bridge and culvert work includes 1,341 ft. of steel girder spans (1,550 tons), 13,700 cu.yd. plain concrete, 5,500 cu.yd. reinforced concrete, 2,646 ft. of ballasted deck pile trestle and 560 ft. of open deck pile trestle. Creosoted timber is used for pile and frame trestles. These trestles have six-post bents and 14-ft. spans. Their maximum height is 60 ft., with framed bents on the piles. The timber is treated at the company's plants with 14 to 16 lb. of creosote per cubic foot; all cutting and shaping is done before treatment. This railway's experience with trestles of treated timber was given in *Engineering News-Record* of April 13, 1923, p. 611.

Foundation Work—Of forty concrete piers and abutments only ten were on creosoted piles, the others being on solid rock. Concrete arches and box culverts were on rock or good earth foundation. In constructing a pier for the Walnut River bridge (Fig. 2) a concrete retaining wall was encountered within the masonry limits. As this wall did not extend to rock it had to be underpinned to a depth of 4 ft. and for a length of 12 ft. No shoring was used, the excavation for half the length being made and concreted before disturbing the second half. Floods caused considerable trouble with the three piers at the Cottonwood River crossing. The cofferdam for the center pier was set three times and each time was washed out by floods which raised the water level more than 30 ft. within a few hours. The best that could be done was to save the timber by means of wire cables attached to various parts of the structure.

Concreting—For concrete work on 106 structures scattered along the line a large number of mixing plants were installed, no attempt being made to transport concrete in cars. Piers and abutments range in height from 18 to 34 ft. of neat-work, with from 5 to 15 ft. of footing. The lighter footings rest on creosoted pile foundations. Arches are 14- to 18-ft. span. Single barrel culverts vary from 2x2 ft. to 10x10 ft. and double-barrel culverts are 6x6 ft. and 8x6 ft. The concrete mix is 1:3:5 for neat-work in piers, abutments and arches; 1:3:6 for footings; and 1:2:4 for culverts.

Sand obtained forty miles away is pumped into gondola cars and shipped to four separate unloading stations. At the two larger stations, sand bins and bunkers have been erected and the sand is unloaded by clamshell buckets which also transfer the sand from bins to bunkers. At the two smaller unloading stations, the sand is unloaded by hand from the cars to trucks. Crushed limestone, used throughout as the aggregate, is obtained from a quarry at Eldorado which

FIG. 3—ELLINOR-ELDORADO CUTOFF; A., T. & S. F. RY.

furnishes 1-in. stone for the 1:2:4 mixture and 2-in. stone for the other mixtures.

Hauling of concrete materials is done by motor trucks and no great difficulty has been experienced in reaching the construction sites. While the roads are extremely slippery in wet weather, they dry quickly and approach the consistency of hard rubber under normal weather conditions. Even the cattle ranges and cultivated fields furnish firm trails for heavy loads when reasonably dry. Suitable water has been obtained at many of the construction sites, but for work adjacent to Eldorado city water has been used. In a few instances, it has been necessary to haul water to work at minor culverts, thus materially increasing their cost.

Portable concrete mixers are used throughout and at minor structures they are located within a few feet of the work, wheelbarrows delivering the materials to the mixer and the concrete to the forms. On the heavier construction work for piers and abutments, ¾-yd. mixers are used, with derricks to place the concrete and also

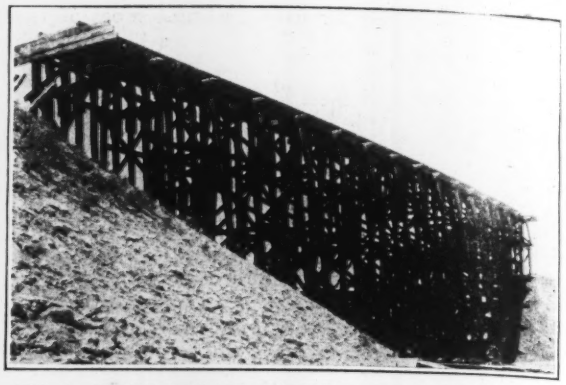


FIG. 5—FRAMED 60-FT. TRESTLE AT CROCKER CREEK

twenty-eight sets of test ties. Crushed stone ballast used in rock cuts and on rock fills will be 12 in. deep under the ties, averaging 3,800 cu.yd. per mile. Earth fills will have stone screenings 8 in. deep under the

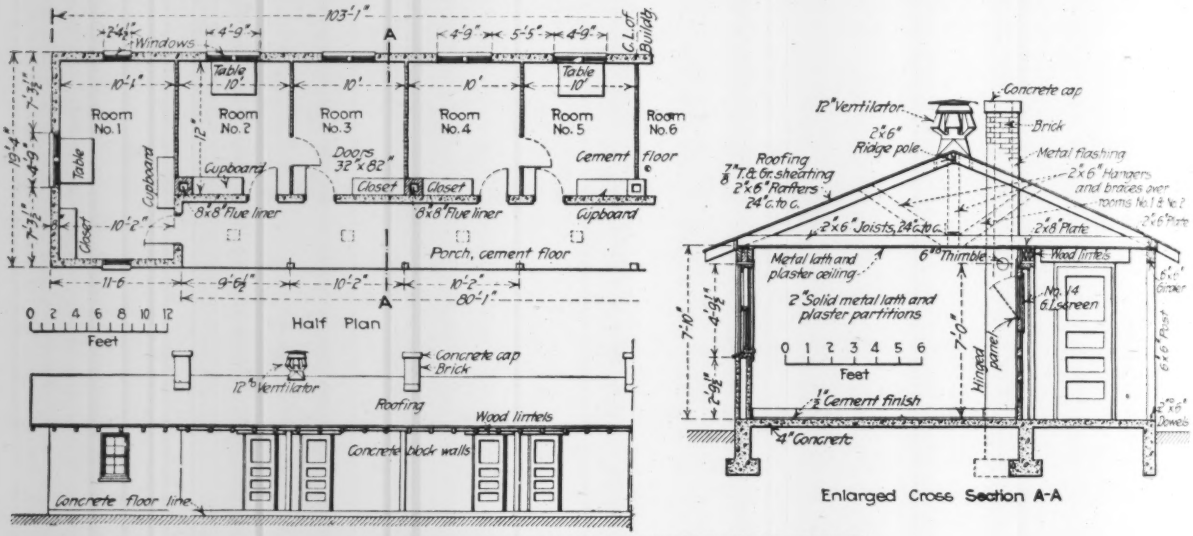


FIG. 6—HOLLOW-BLOCK CONCRETE BUNK HOUSE

to handle foundation excavation and drive piles. Heavy material is encountered in much of the bridge and culvert excavation. The clay top soil is hard to handle, whether wet or dry. The underlying limestone is in various stages of disintegration and requires special treatment for each individual foundation.

Shortage of labor on the concrete bridge work was experienced owing to activity in concrete construction, industries east of Chicago having taken considerable labor from points as far west as Kansas City. For that reason, most of the labor has been gathered from the smaller local towns, much assistance being rendered through the State Labor Agency at Wichita. Mexican and negro labor were also employed to a considerable extent.

Track and Sidings—For the main line, 90-lb. rails of Santa Fé section in 39-ft. lengths are used, having suspended joints spliced with 24-in. angle-bars and four ⅞-in. bolts. Steel shoulder tie-plates 7½x9 in. are laid on all ties, which are of creosoted pine, spaced 3,200 per mile. Experimental ties will be laid at the north end, consisting of 28,000 ties of fourteen different kinds of wood, each with two varieties of treatment, making ties and averaging 2,200 cu.yd. per mile, to be covered later with crushed stone as the fill settles. Rail anchors averaging 1,860 per mile will be applied to prevent creeping.

Passing sidings 5,000 ft. long for 100-car trains are to be provided at intervals of about seven miles. The turnouts will have No. 10 frogs and 16.6-ft. switch rails. These tracks and all other sidetracks, including house tracks at stations, will be laid with 85-lb. relay rail removed from main track, spliced with second-hand angle-bars and tie-plates and having 2,640 second-class creosoted ties per mile. No freight yards are included on this line. Electric interlocking plants will be provided at Ellinor and Eldorado.

Stations and Buildings—At each of the three stations south of the present station at Bazar there will be a combined passenger and freight building, with a residence for the agent; also a section foreman's house, section tool house, stock yard and a ten-room bunk house for section men. All these buildings are of frame construction, except that the bunk houses are of concrete blocks of a standard design adopted by the Santa Fé Ry. and shown in Fig. 6. This bunk house for ten

men has walls of hollow concrete blocks 8x8x16 in., a concrete floor and a wood truss roof with plank sheathing covered with composition shingles. The partitions and ceiling are of plaster on metal lath. The two end rooms are wider than the others and the space between these projecting ends is covered by a wide porch. This type of construction is said to cost little more than a frame building and is more permanent; besides, it is sanitary and requires little maintenance. The hollow wall also helps to keep the building cool in summer and warm in winter There will be no shops, enginehouses or coaling stations on the new line.

Water Service and Reservoir—Two water stations are provided. The first one south of Ellinor takes its supply from the Cottonwood River, which has considerable underflow, although parts of the stream run dry during periods of severe drought. Water is pumped from a large intake well on the river bank to a 200,000-gal. steel tank for softening treatment, flowing thence to a 300,000-gal. capacity steel service tank.

A reservoir of 350,000,000 gal. capacity, built by the railway, will serve the second water station about twenty-four miles distant, where the water will be impounded by an earth dam 2,200 ft. long having slopes of 3 to 1 on the upstream side and 2 to 1 on the downstream side. Near the center of the dam will be a 12-in. plain concrete core wall, anchored into the rock foundation and extending one foot above the bottom of the relief opening or spillway, which will consist of a 135-ft. channel cut through solid rock. Valves will be placed in an intake well at the toe of the slope in the deepest part of the stream. From this well the water will flow in a gravity pipe line 4,000 ft. to the booster pumping station and thence through 25,000 ft. of nearly level pipe line to the 300,000-gal. steel service tank. Pumps will be operated by internal combustion engines and water will be supplied to locomotives through 10-in. water columns.

Engineers and Contractors—This new Ellinor-Eldorado line is being built by the Eldorado & Santa Fé Ry. Co., as a subsidiary of the Atchison, Topeka & Santa Fé Ry. The work is under the direction of C. F. W. Felt, chief engineer of the A., T. & S. F. Ry. System; A. F. Robinson, bridge engineer, and J. W. Stewart, engineer in charge of construction. The Bates & Rogers Construction Co., Chicago, has the general contract and is carrying out all the concrete work; R. E. Ross is the company's district manager and W. E. Scott is its engineer on the work. Grading and bridging were sublet to Peterson, Shirley & Gunther, Omaha, Neb.; buildings to the Jarrett Construction Co., Springfield, Mo., and tracklaying and ballasting to Roberts Brothers, Chicago. Steel bridge erection is done by the railway company's forces. The total cost of the railway will be about $3,500,000 and it is expected to put the line in operation before the end of 1923.

Cement-Lined Cast-Iron Pipe at Liverpool

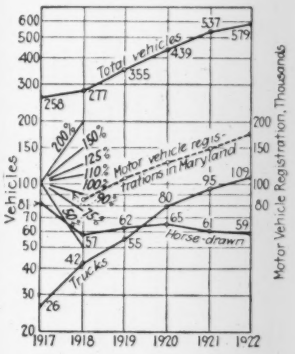
A new cast-iron water supply main from one of the storage reservoirs into the city of Liverpool, England, is being lined with what the London *Engineer* describes as "a strong cement mortar applied by the special spinning process of the Stanton Ironworks Co. The main is 6½ miles long, 42 in. in diameter for half its length and 40 in. for the remaining portion.

Six Years of Traffic Counts on Maryland Roads

Traffic Increase Approaches Fixed Rate Closely Approximating Rate of Increase in Population

THE STATE Roads Commission of Maryland has conducted a traffic census, the results of which now cover six complete years, 1917 to 1922, inclusive, states A. N. Johnson, chairman of the Executive Committee, Advisory Board on Highway Research, National Research Council, Washington, D. C., in a recent report to the board. The counts were taken at approximately 200 stations throughout the state highway system. The mileage to which the traffic counts apply is approximately 1,600 miles. The counts were taken at the same stations during the six-year period, one day per month, on different days of the week. The results are best seen by reference to the accompanying chart.

First, attention is called to the increase in the average daily number of vehicles per mile over the state highway system—from 258 vehicles in 1917 to 579 vehicles in 1922. It is noticed, however, that the rate of increase is flattening (the diagrams being drawn to semi-logarithmic platting, the slopes of the lines indicate the true relative rate of increase). Whereas the rate of increase for the period 1918 to 1921 is approximately 25 per cent, from 1921 to 1922 it is but little over 10 per cent. It is of interest to compare this rate of increase with the rate of increase of motor vehicles registration, shown by the dotted line. It is seen that for the four years the increase in motor vehicle registration is nearly constant (about 20 per cent per year); and that the rate of increase in total traffic has lessened somewhat in advance of what we may expect for motor vehicle registration. Both of these curves, it would be expected, ultimately would closely follow the population curve.



INCREASE IN HIGHWAY TRAFFIC, MARYLAND

Daily average number of vehicles per mile over Maryland state highway system showing relative rate of increase for years as indicated.

The traffic counts show the number of horse-drawn vehicles, and the number of trucks. It is to be noted that the amount of horse-drawn traffic has varied but little in the past five years, being almost constant in amount, while the rate of increase in truck traffic has been rapid, averaging for the four years, 1917 to 1920, nearly 50 per cent a year. The curve then shows a somewhat marked decrease in the rate for 1920 to 1922 inclusive, and the rate of 20 per cent for this period indicates that we may expect the rate of increase in truck traffic to be greater than the average for all traffic.

These conclusions indicate the value of a continued census extending over a period of years in determining traffic trends of importance in highway planning.

Levees on Mississippi Tend To Lower River Bed

Low-Water Gage Readings in Lower St. Francis and Reelfoot Basins Over Long Period of Years Submitted in Proof of This Contention

BY CHARLES L. POTTER
Colonel, Corps of Engineers, U. S. Army
President, Mississippi River Commission, St. Louis, Mo.

THERE IS widespread popular belief that the continued action of levees raises the bed, or the low-water plane, of a river. Even among engineers, it has been claimed that proof of the lowering of a river bed due to the action of levees has never been furnished. The Mississippi River Commission claims that levees at least tend to lower the river bed.

The best opportunity to study this question on the Mississippi River is afforded in that stretch of the river along the Lower St. Francis Basin in Missouri and Arkansas. This basin has a river frontage of 236 miles, from New Madrid (71 miles below Cairo) to Helena (307 miles below Cairo and about 8 miles below the mouth of the St. Francis River). The construction of modern levee systems in that section was not begun until 1893, except for about 60 miles on the east bank of the river in the upper end of the Upper Yazoo District. The Lower St. Francis system includes 218 miles of levees on the west bank and the Reelfoot system 21 miles on the east bank—all now complete to final length. Thirty years ago the floods in that section were free from restraint—completely free on the west bank of the river and in the Reelfoot Basin. The St. Francis is the only important tributary entering that section of the Mississippi River. This enters so near the lower end of the section that the water passing Cairo is practically the same as that reaching a point 10 miles above Helena.

While the main purpose of levees is to protect the alluvial basins by confining the flood waters, it is claimed that they also improve the low-water channel by keeping high-water flow as nearly as possible in the same stream line as low-water flow. High-water comparisons are unreliable because of the complications

TABLE SHOWING LOW WATER GAGE READINGS ON THE MISSISSIPPI—CAIRO TO HELENA—1882 TO 1921 INCLUSIVE

	Elevation above Mean Gulf Level								Depression below Cairo						
Year	Cairo	Columbus	New Madrid	Cottonwood Pt.	Fulton	Memphis	Mhoon Landing	Helena	Columbus	New Madrid	Cottonwood Pt.	Fulton	Memphis	Mhoon Landing	Helena	Remarks
1882	277.7	....	259.7	234.1	215.4	187.7	167.3	150.4	....	18.0	43.6	62.3	90.0	110.4	127.3	
1883	275.1	271.4	257.8	231.5	213.4	186.1	163.8	148.2	3.7	17.3	43.6	61.7	89.0	111.3	126.9	
1884	277.5	273.6	259.9	233.2	214.2	187.3	164.0	149.1	3.9	17.6	44.3	63.3	90.2	113.5	128.4	
1885	278.7	274.7	261.3	....	215.0	188.4	....	149.8	4.0	17.4	....	63.7	90.3	....	128.9	
1886	274.2	271.2	258.0	....	212.6	186.7	....	144.8	3.0	16.2	....	61.6	87.5	....	129.4	
1887	272.2	268.2	256.3	....	210.3	185.0	....	141.6	4.0	15.9	....	61.9	87.2	....	130.6	
1888	275.5	272.1	259.5	....	213.9	188.2	....	146.4	3.4	16.0	....	61.6	87.3	....	129.1	
1889	273.0	269.6	257.8	230.2	211.0	185.8	163.6	143.4	3.4	15.2	42.8	62.0	87.2	109.4	129.6	
1890	279.1	275.5	263.5	235.6	216.4	191.4	169.5	151.8	3.6	15.6	43.5	62.7	87.7	109.6	127.3	
1891	272.5	268.0	258.5	230.1	211.4	185.2	163.0	142.7	4.5	14.0	42.4	61.1	87.3	109.5	129.8	
1892	274.3	269.1	259.4	230.9	213.5	185.8	163.6	143.0	4.2	14.9	43.4	60.8	88.5	110.7	131.3	First allotment made for levees in Lower St. Francis District. Annual report states that the only levees in this district are at Plum Point—built for channel improvement.
1893	275.0	270.4	260.5	232.3	214.2	186.8	159.5	144.5	4.6	14.5	42.7	60.8	88.2	115.5	130.5	
1894	273.2	267.3	257.6	229.1	210.5	182.8	154.1	139.6	5.9	15.6	44.1	62.7	90.4	119.1	133.6	
1895	271.5	266.5	256.5	227.2	208.9	181.6	153.6	138.8	5.0	15.0	44.3	62.6	89.9	117.9	132.7	
1896	276.0	272.0	260.9	232.7	213.4	186.0	159.1	145.8	4.0	15.1	43.3	62.6	90.0	116.9	130.2	
1897	272.9	268.3	257.8	229.0	211.5	184.5	154.0	141.0	3.6	15.1	43.9	61.4	88.4	118.9	131.9	St. Francis levees contain 5 million cu.yd.
1898	278.1	274.1	262.4	235.1	215.3	188.7	162.2	149.6	4.0	15.7	43.0	62.8	89.4	115.9	128.5	
1899	273.4	269.4	258.6	230.3	211.4	184.8	156.6	143.5	4.0	14.8	43.1	62.0	88.6	116.8	129.9	
1900	276.2	272.6	261.2	233.0	213.0	186.3	157.5	146.6	3.6	15.8	43.2	63.2	89.9	118.7	129.6	St. Francis levees contain 12 million cu.yd.
1901	273.3	270.1	259.2	230.2	210.3	183.9	157.6	143.3	3.2	14.1	43.1	63.0	89.4	115.7	130.0	Reelfoot District first mentioned. Levee content 140,000 cu.yd.
1902	277.7	274.0	262.8	234.0	213.0	187.1	163.3	148.2	3.7	14.9	43.7	64.7	90.6	114.4	129.5	
1903	273.3	269.5	258.8	230.9	210.0	185.2	157.7	144.6	3.8	14.5	42.4	63.3	88.1	115.6	128.7	
1904	273.5	269.3	258.3	229.8	209.0	184.9	157.0	144.1	4.2	15.2	43.7	64.5	88.6	116.5	129.4	
1905	281.4	277.4	265.0	236.7	215.4	189.8	165.6	151.0	4.0	16.4	44.7	66.0	91.6	115.8	130.4	
1906	282.3	278.5	266.1	237.6	216.1	190.8	166.5	151.6	3.8	16.2	44.7	66.2	91.5	115.8	130.7	
1907	279.9	276.8	264.0	236.1	215.6	190.7	165.0	150.8	3.1	15.9	43.8	64.3	89.2	114.9	129.1	St. Francis levees contain 19 million cu.yd. Reelfoot levees contain 1¼ million cu.yd.
1908	274.7	271.4	259.7	230.1	212.2	187.7	159.8	145.8	3.3	15.0	44.6	62.5	87.0	114.9	128.9	
1909	277.4	273.9	262.7	232.7	214.1	189.7	161.6	147.5	3.5	14.7	44.7	63.3	87.7	115.8	129.9	
1910	275.5	272.0	260.4	230.7	211.6	187.4	159.5	145.0	3.5	15.1	44.8	63.9	88.1	116.0	130.5	
1911	278.2	274.2	262.6	233.1	213.1	189.5	162.2	146.7	4.0	15.6	45.1	65.1	88.7	116.0	131.5	
1912	279.8	275.9	264.2	233.9	214.4	190.8	164.2	147.7	3.9	15.6	45.9	65.4	89.0	115.6	132.1	St. Francis levees contain 28 million cu.yd.
1913	276.9	272.8	261.4	230.6	212.2	188.9	161.2	144.2	4.1	15.5	46.3	64.7	88.0	115.7	132.7	Reelfoot levees contain 2 million cu.yd.
1914	277.8	272.7	260.4	230.0	211.0	187.2	161.1	142.9	5.1	17.4	47.8	66.8	90.6	116.7	134.9	Last crevasse in either district.
1915	283.6	279.3	265.9	237.1	216.9	193.7	168.6	151.6	4.3	17.7	46.5	66.7	89.9	115.0	132.0	
1916	276.2	272.8	260.2	230.8	210.9	187.0	161.3	144.9	3.4	16.0	45.4	65.3	89.2	114.9	131.3	
1917	274.4	271.0	257.3	228.8	....	....	....	....	3.4	17.1	45.6	....	....	....	....	Low water omitted below Cottonwood Point, being affected by ice gorge.
1918	277.3	273.4	259.0	230.3	210.4	186.1	158.9	143.5	3.9	18.3	47.0	66.9	91.2	118.4	133.8	
1919	277.4	273.8	259.2	230.5	210.9	187.6	158.9	144.9	3.6	18.2	46.9	66.5	89.8	118.5	132.5	
1920	279.0	275.9	260.9	232.1	212.1	188.5	160.5	147.1	3.1	18.1	46.9	66.9	90.5	118.5	131.9	
1921	280.4	276.3	261.2	232.2	212.3	187.5	161.6	146.9	4.1	19.1	48.2	68.1	92.9	118.8	133.5	St. Francis levees contain 51 million cu.yd. Reelfoot levees contain 3 million cu.yd.
Average for 10-year periods																
1882 to 1891 inclusive									3.7	16.6*	43.4	62.2	88.4	110.6	128.7	Natural state.
1892 to 1901 inclusive									4.2	15.1	43.4	62.2	89.3	116.5	130.8	Levee work begun.
1902 to 1911 inclusive									3.7	15.4	44.2	64.4	89.1	115.7	129.9	Levee work partially complete.
1912 to 1921 inclusive									3.9	17.3	46.7	66.4	90.1	116.9	132.7	Levees completely effective.

*Increased 0.3 on account of change in location of gage (1 mile downstream) in 1893.

arising from the reservoir effect (which varies greatly depending on whether the river rises rapidly or slowly) and because of the elevation of bars, which accompanies all high waters. Changes in low-water conditions, when all bars have been again lowered, and when the filling or emptying of the river's own reservoir is well past, give a better idea of the changes that have actually been effected in the bed of the river.

In order to fully cover the territory in question, all gages from Cairo to Helena have been studied. These gages are located as follows:

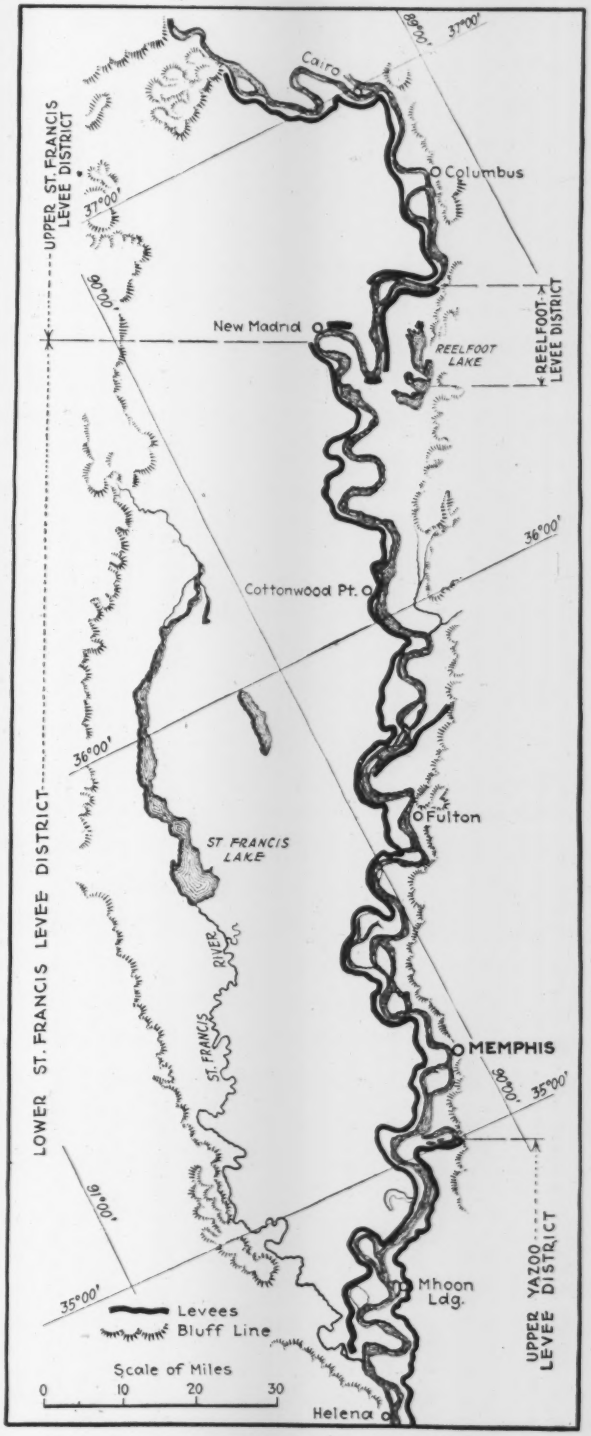
Cairo	at Cairo
Columbus	21.6 miles below Cairo
New Madrid	71.0 miles below Cairo
Cottonwood Point	124.5 miles below Cairo
Fulton	175.4 miles below Cairo
Memphis	227.0 miles below Cairo
Mhoon Landing	273.2 miles below Cairo
Helena	307.1 miles below Cairo

All of these gages were established prior to 1882, and have been read regularly since that date, although a few blank years occur in the readings of some of them.

For the purpose of discussion, the records of these gages for 40 years—1882 to 1921, inclusive—have been taken and a table has been prepared which shows, in the first eight columns, the elevations above Mean Gulf Level of the low stage for each season. Care has been taken to follow the same low-water trough through from gage to gage. Actual gage records may not show the low water used in the table as occurring within the calendar year named. That for 1887 actually occurred in January, 1888. Winter low waters have been avoided when possible in order to eliminate the effects of ice. The second series of columns (headed "Depression Below Cairo") shows the differences between the Cairo elevation and the elevations of the same low-water trough as it reached the gages below Cairo. Changes in "Depression" table show what has happened to the low-water plane in 40 years. Such records necessarily show fluctuations from year to year. The effect of these has been reduced by taking the averages of the changes for 10-year periods.

It will be noted that there is very little change in gage relations between Cairo and Columbus. This was to be expected since the two gages are only 22 miles apart; there are no levees between them on the east bank; and the west bank levees are not yet up to Commission grade or section, nor is the basin completely inclosed. The incomplete line ended 16 miles (river distance) above Columbus in 1900, 8 miles below Columbus in 1905, and about 25 miles below Columbus in 1921, still lacking 12 miles of levee (about 24 miles by river) of closing the basin at that time. Many crevasses occurred in these levees in their earlier stages, thus nullifying their effect on the river bed.

With this exception it will be seen that, with the building of the levees, there has been a decided lowering of the low-water plane at all gages, as compared with its elevation at Cairo, or Columbus. Memphis shows less lowering than other gages. Natural and artificial changes in that vicinity account for this. Two bridges with their approaches have been constructed and the river has been shortened considerably by leaving Hopefield Bend. All of these have their effect. Memphis, however, shows a decided lowering of the low-water plane between the flood of 1916 and the year 1921. It is probable that this lowering of the low-water plane, coupled with a more rapid rise than occurred in the river below Helena, thus adding to the reservoir effect, accounts for the fact that the flood of 1922 did not go as high at Memphis as might have been expected from the stage at Cairo.



THE LEVEE SYSTEM OF THE MISSISSIPPI FROM CAIRO TO HELENA

At New Madrid the low-water plane was raised 1.5 ft. between the first and second decades. At that

time there were no levees in the Reelfoot basin and the flood flow went unrestrained across the low places in Slough Landing Neck, causing a fill in New Madrid Bend which the subsequent low-water flows failed to remove. The plane was lowered 0.3 ft. between the second and third decades, with partial closure of the Reelfoot basin. With completely effective levees in this basin, forcing the flood flow into New Madrid Bend, the low-water plane at New Madrid was lowered 1.9 ft. between the third and fourth decades. The plane was raised 1.5 ft. before levee building began and has been lowered 2.2 ft. with the construction of the levee systems. The spillway for flood waters across Slough Landing Neck caused a permanent rise in the river bed at New Madrid. On its closure the river bed again lowered. [NOTE: In order to make clear the situation at this point it should be stated that the earthquake of 1811 raised the ground at New Madrid and on parts of Slough Landing Neck so that the level is above flood surface. This makes it possible to protect the Reelfoot basin and to completely shut off the flood across the neck by one levee of two sections, on its upstream side.]

From this study one of two conclusions must be drawn: (a) The river bed has been lowered, during the period covered, at all gages below Columbus; or (b) the river bed has been raised at Columbus. Either conclusion will disprove the popular impression that levees cause an elevation of the river bed. If the river bed has been lowered at all gages below Columbus, no other agency than levees could have accomplished it. If the river bed has been raised at Columbus where levees had little effect, and has not been raised, or has been raised less, below Columbus where effective levees were being constructed, it is plain that the levees have at least prevented a rise equal to that which took place at Columbus.

What has occurred at Columbus may be shown by a study of discharge observations at that point:

Average of two measurements (river at low water stand) in 1882 at 9.6 gage was...	178,000 sec.-ft.
Average of two measurements (river rising very slowly) in 1896 at 9.6 gage was....	190,000 sec.-ft.
Average of four measurements (river falling very slowly) in 1882 at 12.3, 12.4, 12.6 and 12.7 gages (averaging 12.5 gage) was	202,000 sec.-ft.
Average of four measurements (river at low water stand) in 1900 (all at 12.5 gage) was	209,000 sec.-ft.
Average of two measurements (river falling very slowly) in 1882 at 10.9 gage was...	190,000 sec.-ft.
Average of two measurements (river at low water stand) in 1908 at 10.9 gage was..	188,000 sec.-ft.

The variations are so slight that it may be safely said that there was no noticeable change in the elevation of the low-water plane at Columbus from 1882 to 1908.

There is but one possible conclusion remaining: That leveeing the Lower St. Francis and Reelfoot basins has materially lowered the low-water plane at New Madrid, Cottonwood Point, Fulton, Memphis, Mhoon Landing and Helena. This of course cannot fully solve the problem of maintaining a navigable channel, since the river, at whatever level, will always run in a succession of bars and pools, but lowering the low-water plane tends to stabilize the regimen of the river and to fix the navigable channel. With levees supplemented by adequate bank protection, exact solution of the problem of fixing and maintaining a navigable channel by dredging will be more nearly approached.

Failure of a Concrete Reservoir of Curious Design

Four Sides Fall Out of Square Structure with Beam and Slab Walls Tied at Corners by Exposed Diagonal Rods

By J. C. PINNEY
Dean of College of Engineering, Marquette University, Milwaukee, Wis.

A SQUARE concrete reservoir of 1,250,000 gal. capacity at the plant of the Cudahy Brothers Co., Cudahy, Wis., collapsed Dec. 24, 1923. It had been completed but a short time previously. Each of the four walls of the reservoir fell outward. The southern wall struck the brick wall of the packing plant which

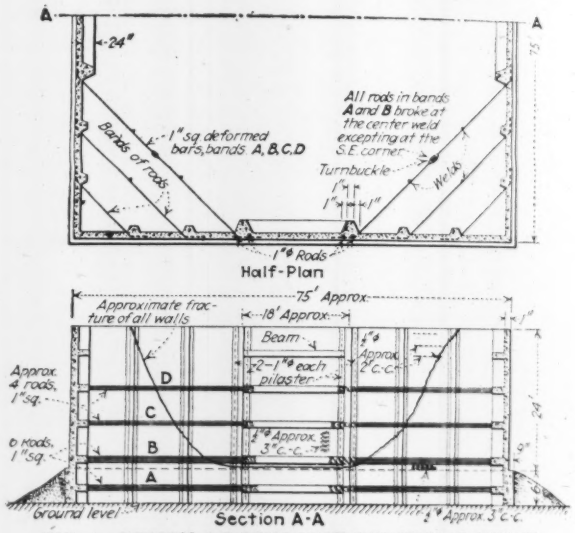


FIG. 1—DESIGN OF CONCRETE RESERVOIR WHICH COLLAPSED

was but a few feet away, knocking out a considerable portion of this wall, as shown in Fig. 3. The north wall struck a corner of the brick veneered office building, doing slight damage. At the time of the accident the reservoir, which stands about 30 ft. high, contained water to within about 6 ft. of the top.

As seen by the plan, Fig. 1, the reservoir was approximately 75 ft. square, symmetrical about both center lines. The construction was of reinforced concrete, and the walls were 21 in. thick up to a point about six feet above ground level, from which place to the top

FIG. 2—WRECKED SOUTH WALL OF CONCRETE RESERVOIR

the thickness was approximately 1 ft. On the inside of the walls were pilasters, the two center pilasters being 18 ft. apart on centers; they extended about 2 ft. inward from the wall and varied in thickness from one to three feet. The central 18 ft. of each of the walls was of the beam and slab type of construction, the beams extending between the two central pilasters.

An interesting feature of the design is that the reactions of these beams were evidently intended to be carried by bands of 1-in. square deformed bars which extended across the corners of the reservoir and engaged in similar beams of adjacent walls. There were approximately four bands of rods connecting the central portions of the wall, the two lower bands consisting of six bars each, and the two upper bands of probably four bars each. Each rod of these bands had at the center a 1¼-in. round rod butt welded to it. These round rods engaged in turnbuckles for adjusting purposes. Steel angles, 3½x3½x⅜ in., placed upright, held these bands in alignment.

The two smaller pilasters between the central portion of each wall and the corner were similarly tied together by hands of about four rods each, placed at the same elevations as the longer bands. The walls between

FIG. 3—CENTRAL 18-FT. LENGTH OF 75-FT. SOUTH WALL

the corners and the 18-ft. central portion were reinforced longitudinally by ½-in. rods. These rods were spaced about 3 in. c. to c. at the bottom, increasing to about 24 in. c. to c. at the top. The reinforcing of the wall in the central 18-ft. portion consists of ½-in. rods placed 3 in. c. to c. The reinforcement of the beams in this central portion is unknown. The large pilasters, which carried the ends of the beams in the central 18-ft. portions, were reinforced by two 1-in. round rods placed on the outside of the pilasters. The square deformed rods connecting one wall with another had an embedment of about 5 ft.

It is interesting to note that all four walls collapsed, and each of the four walls fractured approximately along the same lines. At the time the writer visited the plant, which was about two weeks after the accident, three of the four corners were standing, and the fourth had either gone out at the time of the wreck or had been subsequently torn down. The approximate

FIG. 4—DIAGONAL RODS ACROSS CORNERS OF RESERVOIR
Showing condition of rods at northeast corner.

line of fracture shown in the sectional elevation, Fig. 1, applies to each of the four walls. The views in Figs. 2 and 3 illustrate very clearly how the 18-ft. central portion of the wall fell outward and apparently tipped over.

The rods tying the walls together at the corners of the reservoir are all broken. Fig. 4 shows the condition in the northeast corner. It is also interesting to note that all these rods without exception broke at the weld.

The writer has been unable to obtain the plans of this reservoir, or any information as to its design and construction, other than such few measurements as he was able to take at the site. It is quite evident, however, that the rods in bands *A* and *B*, connecting the 18-ft. central portions of the walls, were called upon to carry a considerable load. It may easily be that these rods were overstressed to the point of breaking, which would naturally result in completely upsetting all other conditions and in the collapse of the reservoir. The absolute uniformity in the destruction of each of the four walls tends to show that there was somewhere a very serious error in stress calculations.

The only purpose which the pilasters in the 18-ft. central portion could serve would be to support the ends of the cross beams, as their reinforcement was not placed in a position to render them able to sustain any portion of the water pressure. The design, as well as the destruction, furnishes rather an interesting example for anyone tempted to design a similar structure, and the calculations of the designer would be of a considerable interest.

Development of Water Power in Finland

The Finnish State has commenced the development of water power at Imatra Falls on the Vuoksen River, according to the British journal, *Engineering*. Prior to the regulation of a lake above the falls, the flow of 600 cu.m. per second will produce 153,600 turbine hp., and after regulation 250,000 hp. The first installation will be 70,500 hp. Although this is the most important of the developments now under way there are other large water falls capable of producing a large amount of power, including fall on the Vuoksen, the Kymmene, the Kumo and the Ule rivers, which without any regulation have an estimated capacity of 875,000 turbine hp., of which about 10 per cent has been developed. The total capacity of Finland's entire water power is estimated at 1,060,000 hp. at time of low flow, and 2,540,000 hp. at time of peak flow.

Studies of Outlets and Crops on Sewage Irrigated Areas

Terra Cotta Pipe Lines Used and Several Designs of Concrete and Concrete-Protected Cast-Iron Outlets Tried—Comparative Yields of Irrigated and Non-Irrigated Land

By George A. Mitchell
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As a result of studies of sewage outlets from laterals on small institutional sewage-irrigation areas in New Jersey, Pennsylvania and Delaware the Division of Agricultural Engineering of the United States Department of Agriculture, after trying several designs, has found one which promises to give satisfaction. The main features of the latest and presumably permanent type are a cast-iron outlet discharging horizontally, with the outlet and the sheet-steel uptake leading to it from the vitrified pipe lateral protected by a cone of concrete. This article will describe the several types and variations of outlets that have been tried and will close with some comparative yields of crops on sewage-irrigated and non-irrigated land. The

FIGS. 1 AND 2—CONCRETE SEWAGE OUTLETS IN DITCH BANKS
Sewage distributed from ditch along upper side of field. Washout at A, Fig. 1, led to covered outlet, Fig. 2.

arranged in fan shape, then run into ponds and allowed to soak away. In 1913 about three acres of land were graded for irrigation and a 6-in. terra cotta pipe, with 8-in. Williams valves spaced at 20-ft. intervals, was laid

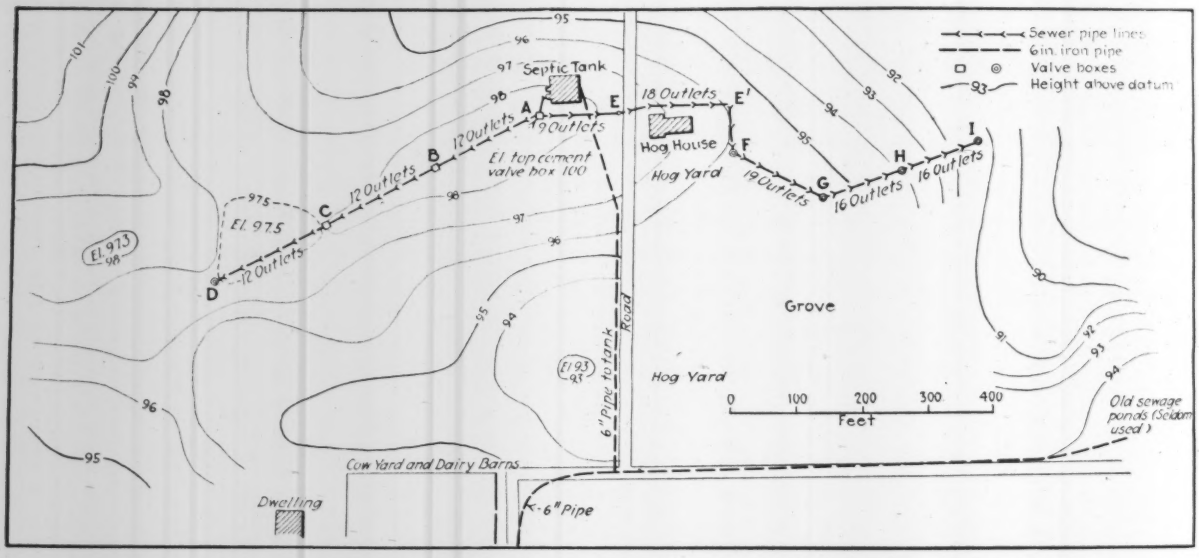


FIG. 3—LAYOUT OF SEWAGE FARM, STATE INSTITUTION FOR FEEBLE-MINDED, VINELAND, N. J.

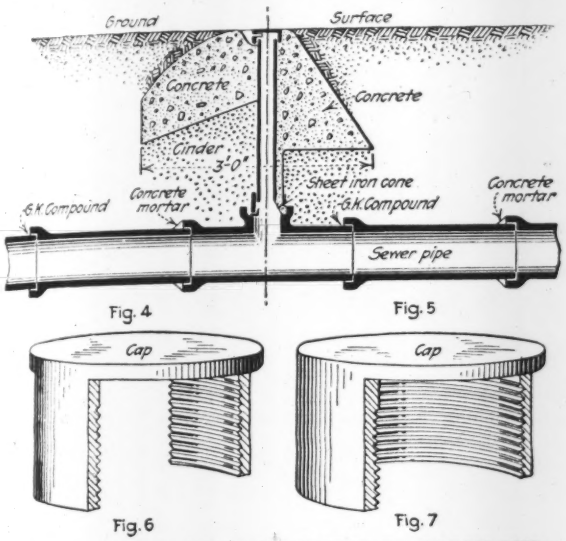
investigations outlined have been carried on principally at the institutions listed in Table I.

Requirements for Sewage Irrigation—Before describing the studies, the fundamental principles of sewage irrigation for crop production will be stated: (1) The sanitary disposal of the effluent from the tanks. (2) Distribution of the sewage as evenly as possible over a sufficiently large area to make possible the most profitable crop production; from 50 to 100 people to an acre has proved successful, although a larger population per acre is permissible. (3) Construction of a system which may be operated with the minimum attention. (4) Choice of crops which will not endanger the success of the enterprise on account of technical or popular disapproval.

The Training School at Vineland, an institution for feeble-minded children, has tried various methods of disposing of its sewage during the past twenty-five years. First a settling tank and then a septic tank was used. The effluent was first distributed over a small triangular plot of ground through furrows across the upper end. At first the distribution was inefficient due to lack of devices for distributing the sewage flow into several equal streams and to lack of knowledge of how to prepare the fields.

Concrete Outlets Set in Ditch Bank—The first successful distribution of the sewage evenly and systematically was effected by setting concrete outlets, 4 ft. apart, in a ditch bank at the upper side of a field (Fig. 1). All the outlets intended for discharging at one time are set level. The defect in this outlet was that sewage would gradually wash the dirt bank away at the side of an outlet (as at *A*). Then as soon as the bank had been cut below the level of the outlet the bulk of the sewage would flow out at this one break.

Covered Outlet Tried—The next attempt was to make a covered outlet (Fig. 2). This is working with fair success. There are, however, two objections: (1) Unless watched so as to keep the top of the bank higher than the top of the concrete arch, the sewage is apt to spill over the top at the beginning of the flushing and gradually to form a crevasse; (2) the oper-



FIGS. 4 TO 7—CONCRETE-PROTECTED CAST-IRON OUTLETS, 1920 AND 1922 TYPES

Fig. 4 shows the 1920 type and Fig. 5 the 1922 type of outlet. Figs. 6 and 7 show the 2-in. caps used for the 1922 outlet. The cap shown by Fig. 6 discharges the sewage in two directions and is used for outlets located at every fourth row of corn. Fig. 7 shows the cap used where there is an outlet for every second row. In the type adopted in 1922, the concrete protection is more cone-shaped and is a better safeguard against damage by cultivators than is in the 1920 type. Note also the different methods of joining the cast-iron outlet pipe to the line of sewer pipe.

ators may dig little trenches through the bank instead of keeping the outlets in order. This method of distribution requires an open ditch, along the sides of which there will be rank weed growth unless kept down by hand labor. Horse cultivation cannot be practiced parallel to the ditch unless hand labor is afterward employed to make little furrows or ditches to connect the cement outlets with rows of crops to be irrigated. These crops are either planted on ridges, as in the case of mangels, or the rows are ridged after planting, by special cultivator teeth, as in the case of corn. The sewage then flows between the rows to the bottom of the slope. Some grading is necessary or at least advisable. That grading is not a serious hindrance to crop growing has been shown at the Training School at Vineland. Here the entire top soil of a considerable area was removed in 1913. On this subsoil corn would not grow 2 ft. high but the application of sewage alone quickly brought the productivity to maximum.

Underground Laterals, Cast-Iron Risers and Outlets—The third attempt to secure equal distribution of sewage consisted of the construction of permanent outlets that could not be changed by those in charge of sewage irrigation and that would withstand ordinary blows from farm tools, horses' hoofs, etc. Also the sewage was conducted in underground pipes instead of in ditches.

The outlets for field distribution of the sewage irrigation system at Lincoln University, Chester Co., Pa., were the first constructed on this final plan. This system consists of a 2-in. iron pipe rising from a 6x4-in. T in the terra cotta main (a special iron casting connecting iron and terra cotta pipes), spaced to come directly in line with every fourth row of corn. The tops of the iron pipe risers are made nearly level along the entire line, T's are screwed on, one end of the T is plugged and a short piece of pipe inserted in the other end. The T's are screwed on so as to slope 2 in. per 100 ft. toward the end. At that time the question of constructing concrete blocks about the risers was under consideration, but this was not done at Lincoln University, due to the fact that a very careful man is in charge. The original plan was to have the sewage discharge from both ends of the T's and so flow down every second space between the corn rows. Experience has shown it to be better to put caps on half the pipes and discharge one stream only from the other half.

There is no valve or valve box at the end of the line, as in later installations, and some trouble was experienced with solid material collecting in the end of the terra cotta pipe line. This difficulty has been obviated since 1921 by leaving the end riser pipe open all the time. The system has given entire satisfaction to the university authorities. About three acres are irrigated and four acres are available for irrigation. The sewage irrigation plant was installed in the spring of 1918. The soil is clay loam. Unless small furrows are made the sewage is practically all absorbed by the soil within 100 ft. of the line of outlets. That is, one-half acre of clay loam land, with a slope of 3 to 7 ft. per hundred, will absorb 10,000 gal. of sewage daily for long periods. Heavy rains carry some of this sewage down the hill.

FIG. 8—CAST-IRON OUTLET
Outlet and conical sheet-iron uptake before placing a concrete protection cone.

Concrete-Protected Outlets of 1920—The next development of outlets was at the sewage irrigation system of the State Institution for Feeble-Minded at Vineland. The map (Fig. 3) shows a 500-ft. line of 8-in. terra cotta pipe, *ABCD*, divided into three sections by concrete valve boxes and provided with twelve outlets per section, one outlet being in the side of the valve box. Here a new plan was adopted. The twelve outlets in each section are at the same level. There is a drop of 6 in. from section to section in the elevation of the outlets. If all the outlets on this 500-ft. line were at the same level the flow from each would be too small to reach to the end of each row. When the system was installed the flow of sewage was about 250 gal. per minute. This gave 20 gal. per minute per outlet which has proven very satisfactory.

The 2-in. iron pipe outlet at the State Institution was at first inclosed with a small cone of concrete.

TABLE I—INSTITUTIONS AT WHICH SEWAGE-OUTLET STUDIES WERE MADE

	Population, 1922
State Institution for Feeble-Minded at Vineland, N. J. (daily discharge of sewage about 140,000 gal.)	970
Training School for Feeble-Minded, Vineland, N. J.	600
Lincoln University, Chester Co., Pa.	265
State Reformatory for Women at Clinton, N. J.	175
Woodbine Colony for Feeble-Minded Males, Woodbine, N. J.	150
Menantico Colony for Feeble-Minded Males, Vineland, N. J.	100
Delaware Colony for Feeble-Minded, Stockley, Del.	40

After a short experience it was seen that these were knocked loose by farming operations and large blocks of concrete resembling segments of a sphere were then used. At this time the 4-in. T-outlets of the terra cotta pipe were fitted with special iron castings on which the 2-in. pipe rested. These 1920 outlets (Fig. 4) are still giving satisfactory service at the State Institution at Vineland, four years after installation. The caps are sometimes knocked off by farm tools, giving a chance for dirt to drop down into the pipe.

Corn has been grown on the sewage-irrigated area. Along the line *EABCD* (Fig. 3) the corn is carefully drilled by the regular farm help so that every fourth row of corn is directly in line with an outlet. In subsequent cultivation the cultivator does not hit the concrete cones, at least not so as to injure them.

Plowing the land in the spring has presented some

FIG. 9—CORN RAISED ON SEWAGE IRRIGATED AND NON-IRRIGATED LAND

difficulties in the matter of leaving the ground with its original slope and no objectionable dead furrows. The best method is to use a reversible plow or depend entirely on a double-cut harrow without plowing. On the remainder of the line at the State Institution and in installations at other institutions, the irrigation outlets occur at every second row. This arrangement requires little hand work. The sewage flows down every other space between the corn rows, thus fertilizing and irrigating one side of every row.

Changes in 1922—In the 1922 irrigation outlet, Fig. 5, the iron pipe is covered with concrete, forming a thin layer at the junction with the sheet-iron cone and filling the bell about the cone. If a heavy tool moves the concrete, the break will occur at the junction of the iron pipe and the sheet-iron cone and can be repaired with comparative ease. Caps, Figs. 6 and 7, are screwed onto the tops of the iron pipes before the concrete cones are built. In building the cone, it is necessary to use a very stiff concrete mortar. The concrete is brought up level with the top of the cap in front of the opening (Figs. 4 and 5). This aids in preventing farm tools from catching in the opening of the sawed-off iron cap. The 1922 outlet is in use at the training school at Vineland, the Woodbine Colony, Woodbine, N. J., and the Delaware Colony, at Stockley, Del.

Probable Permanent Outlet, 1923 Type—The 1923 outlet, which is probably the type that will continue to be used, is shown by Figs. 8 and 10. This casting was used in the sewage irrigation plant for the State Reformatory for Women at Clinton, N. J., installed in November, 1922.

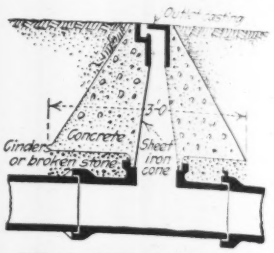


FIG 10—THE 1923 OUTLET
Concrete cone, with uptake formed of sheet iron and outlet of cast iron.

Caps—It was necessary at the Training School at Vineland and at the State Institution at Vineland to run distribution lines down a slight incline, making it impossible to have the outlets level. To meet this situation, in the top of 2-in. caps were drilled holes from ½ to 1 in. in diameter. These caps were screwed on the 2-in. pipe and surrounded by the concrete segment or cone. These two distribution lines have functioned satisfactorily, although the number of outlets required to handle a given flow of sewage was miscalculated in both cases and it became necessary to cut the terra cotta pipe lines and insert valve boxes.

Valve Boxes—The first valve boxes were made square, of concrete or cemented brick. It was necessary to build wood forms for square concrete boxes. Eighteen-

TABLE II—CROP RESULTS WITH AND WITHOUT SEWAGE IRRIGATION, YIELDS PER ACRE

Training School at Vineland, N. J.

	Sewage Irrigated, Bu.	Unirrigated, Bu.
Shelled corn, yellow:		
1916	54	22½
1917	70	10 (no fertilizer)
1919	60	37 (6 tons stable manure per acre)
Silage Corn:	Tons	Tons
1920	13½	12 (6 tons stable manure per acre)

The additional weight of the silage in 1920 on the sewage irrigated corn was mostly ears rather than stalk.

	Tons	Tons
1921	12	11 (soil made fertile by good treatment for several years)

State Institution for Feeble-Minded, Vineland, N. J.

	Bu.	Bu.
Shelled corn, white:		
1919	33	12 (where fertilized only) 23 (where 10 tons manure per acre was used) 28 (where 20 tons manure per acre was used)

1920—All the corn was used for silage and was not measured. The grain from sewage irrigation was so remarkable as to elicit favorable comments from visitors.

Very small plots of sewage irrigated and unirrigated white corn left to ripen showed a yield of 13½ bu. on the unirrigated but lightly fertilized land and 46½ bu. on the irrigated. The white corn used at this state institution makes a large yield of silage, but the yield of ripened grain seems to be less than in the case of the yellow varieties. The soil here previous to installation of the sewage irrigation plant was very poor.

Lincoln University, Chester Co., Pa.

	Bu.	Bu.
Potatoes:		
1920	140	87
Corn (estimated):		
1922	80	50

Eastern Pennsylvania State Institution for Feeble-Minded

	Bu.	Bu.
Corn:		
1917	42	20
Mangels:	Lb.	Lb.
1917	51,000	33,000
Sugar beets:		
1917	50,400	40,600

There were drouths in 1916 and 1917 at the time for the ears to set on the young corn. This accounts partially for the great gains from sewage irrigation in those years.

inch terra cotta pipe was used for three end valve boxes at the State Institution at Vineland, the top being a few inches above the ground level. For later installations sheet-iron forms were used to make concrete valve boxes with an 18-in. diameter. Finally new sheet-iron forms were made on the same plan as the original but for a valve box 2 ft. in diameter. This box seems to be satisfactory.

Terra Cotta Pipes—Considerable trouble from breaking was experienced with cemented terra cotta pipe lines used under pressure in irrigation systems at Spring City, Pa., and Browns Mills, N. J., some years after installation. Thinking that this might be caused by expansion and contraction of the pipe lines an experimental line of 10- and 12-in. terra cotta pipe was installed at Spring City, using asphalt jointing compound. This line has been in use under light pressure three years without a leak showing.

Another line of 6-in. terra cotta pipe has been installed at Clinton, with asphalt jointing compound for all joints. This line runs through an apple orchard. It is proposed to observe the effectiveness of this jointing material in resisting root entrance into the pipe. Asphalt jointing material has been used generally for half the joints of terra cotta pipe on the last line installed at the Training School at Vineland; at Woodbine, N. J.; Delaware Colony at Stockley, Del.; and at Clinton, N. J.

Time Required to Operate—The time required to operate the sewage irrigation system at the State Institution at Vineland, covering about fifteen acres, was recorded by the farm manager from April 23, 1921, to Nov. 15, 1921. During these seven months 103 man-hours and 4 team-hours were expended.

At the Vineland Training School, covering six acres, the operating time was kept by the farm manager from Jan. 1, 1921, to Sept. 1, 1921. The work was done mostly by a high-grade inmate of the institution. Approximately 227 man-hours were spent. Boy-hours would be a better term, as the feeble-minded man in charge has the mentality of a boy.

Crop Results—Table II gives comparative crop results at four institutions from land irrigated and not irrigated with sewage.

Bell-Base Cylinder Piers For a Heavy Warehouse

Foundation on Submerged Site Requires 114 Concrete Piers Sunk to Depths up to 85 Ft.—Hardpan Interrupts Sinking by Dredging—Bases Belled Out under Compressed Air for Bearing

By Ralph H. Chambers
Jarrett-Chambers Co., Inc., Consulting and Constructing Engineers, New York

CONSTRUCTING or sinking foundation piers by either the dredging method or the use of compressed air has become well standardized. The following describes special expedients employed to meet unusual conditions which were unknown and unexpected when the work was begun.

Conditions at the Site—In the fall of 1922, the Standard Milling Warehouse Corporation, of New York, undertook the construction of a large reinforced-concrete building on the waterfront of Jersey City, N. J., for the blending and packing of flour for export. It was intended that the building should be immediately adjacent to deep water so that oceangoing vessels could lie alongside and be loaded directly from the building. A site was selected on the north side of Harsimus Cove, on Pavonia Ave. The plans called for a six-story building 87 ft. wide, 378 ft. long, with the first floor 10 ft. 8 in. above mean sea-level.

The estimated weight of the building and contents, including the foundations, is 80,000 tons, and this load is carried by 114 concrete piers—68 interior piers of 7 ft. outside diameter, 19 waterfront piers of 6½ ft. diameter, and 27 rear and end piers of 5½ ft. diameter. The estimated loads at the bottoms of the piers were about 800 tons on each of the 7-ft. piers, 600 tons on each 6½ ft. pier, and 500 tons on each of the smallest piers.

According to the original borings, rock at the east end of the site lay at a depth of 65 ft. and at the west end 50 ft. below mean sea-level, and the surface of the rock sloped down uniformly from the west end to the east. The records of these borings showed also that the rock carried an overburden of sand about 20 ft. deep covered with mud and soft silt almost up to the water surface. To meet these conditions the plans called for the piers to be sunk to rock, sealed with concrete placed under water, and filled with concrete. The work was begun by building and sinking concrete cylinders of the diameters specified for the piers. The walls of these cylinders were made 12 in. thick except in the case of the smallest piers, whose walls were 9 in. thick. The weight of these cylinders varied from 40 to 95 tons; it was therefore evident that the cylinders should be built at the site.

As has been described, the site was submerged, and underlaid to great depth with soft silt and mud. The bearing capacity of the subsoil was not sufficient to sustain the cylinders until they had penetrated from 30 to 60 ft. into the mud. It was therefore necessary to support them and lower them as they were built up until they were supported by the soil. A working platform over the whole site, on which the cylinders could be supported, was necessary. Fortunately the old piles and caps of the foundations for the pier shed which formerly occupied the site were available and with some repairs and reinforcement were sufficient for this purpose. A timber frame movable from pier site to pier site was provided for each concrete cylinder. This frame rested upon steel beams supported by the old caps, and it in turn supported steel beams from which the concrete cylinders were hung.

Casting and Lowering Cylinders—The forms for the cylinders consisted of concentric steel shells which permitted the concrete cylinders to be poured in lifts of 5 ft. After each pouring the forms were loosened and raised 5 ft. for the next pour. After each 10-ft. length of cylinder was cast the cylinders were lowered 10 ft. Each concrete cylinder was provided with six equidistant longitudinal steel bars, hooped at intervals with small bars. The longitudinal bars were in 10-ft. lengths, upset and connected by turnbuckles. The sectional area of the bars increased toward the tops of the

cylinders as the weight of the cylinders increased. Three of these longitudinal bars, spaced equally around the circumference of the cylinder, were attached by turnbuckles to three heavy screws about 13 ft. long. These screws passed up between the supporting beams on the tops of the timber frames and, by shoe castings and movable nuts, carried the weight of the concrete

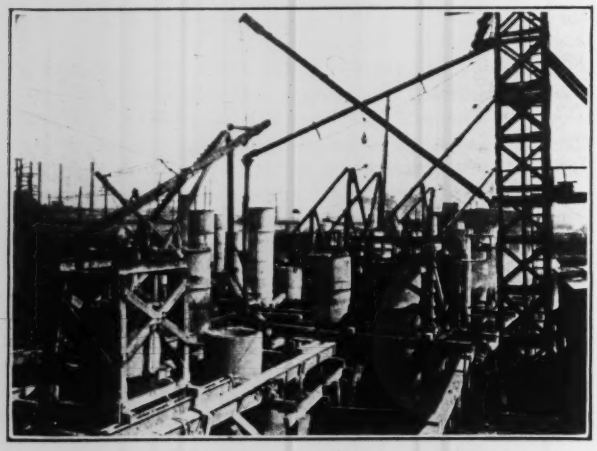


FIG. 1—CASTING AND LOWERING CYLINDERS

cylinder to the supporting beams. The operation of lowering consisted of turning simultaneously the three nuts on the three long screws until the cylinder had been lowered 10 ft., then adding a 10-ft. length of bar to each of the other three longitudinal bars and, by screwing turnbuckles on these bars above the shoe castings, holding the cylinders until the long screws on the other three bars could be uncoupled and removed. Another length was then added to each of the original lowering bars, the screws were again connected, the forms were raised 5 ft., and everything was ready to repeat the operation. Thus the cylinders were always supported at three equidistant points on the circumference, a condition of manifest advantage.

All of the 114 cylinders were cast and lowered in this manner without mishap or failure. The photograph Fig. 1 shows in the foreground one of the lowering frames with the steel forms and lowering screws, and below the forms a portion of the completed cylinder. The same photograph shows in the background a number of cylinders which were being built up and sunk, after the resistance of the subsoil had developed sufficiently to support them and the lowering apparatus had been removed. Sinking was accomplished by means of dredging in the interior wells, by orangepeel buckets, water jets and ejectors. When the exterior soil friction became sufficient to sustain the weight of the concrete cylinders, cast-iron weights were loaded on the tops of the cylinders until the friction was overcome.

Original Borings Prove Erroneous—In the manner described the work was carried on until a large number of the concrete cylinders had been cast and sunk to depths from 30 to 75 ft. During this period it became evident that records of the original borings were entirely misleading. Large numbers of boulders (some of them, as afterwards developed, up to 15 ft. in diameter) and strata of hardpan and hard clay were encountered through which it was impossible to sink the cylinders by dredging methods.

At this juncture a new series of borings was made, and it was found that the rock under the east half of the site lay 89 to 96 ft. below water and under the west half 74 to 89 ft. below water. Furthermore there was an overburden on the rock, 20 to 38 ft. deep, of coarse sand, gravel, hard clay, hardpan and boulders. It was then evident that piers of such small diameters could not be sunk to the rock through this hard stratum by any method, except at prohibitive cost, and it was determined to adopt some means to extend and increase the areas of the bottoms of the piers and thereby to spread the loads over the surface of the hardpan and

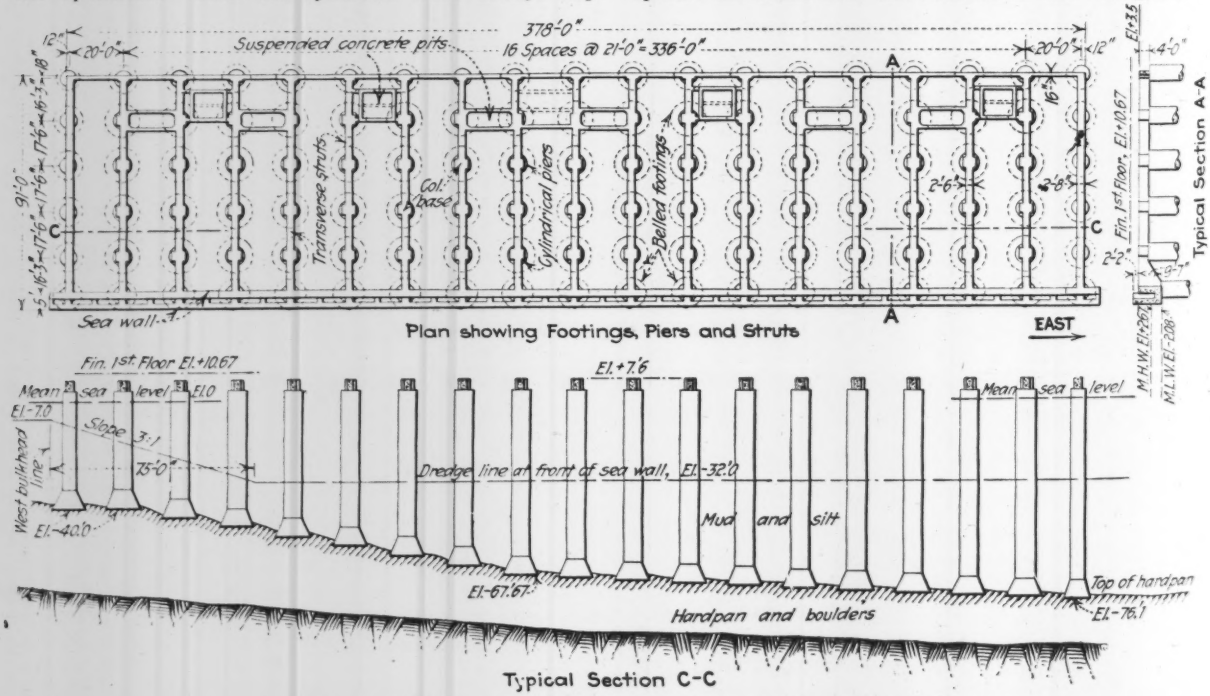


FIG. 2—FOUNDATION PLAN OF STANDARD MILLING WAREHOUSE

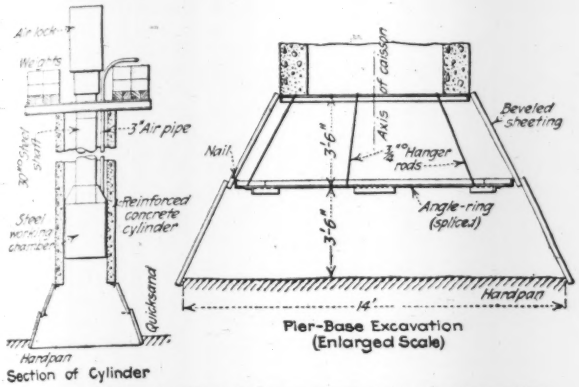


FIG. 3—PNEUMATIC CONSTRUCTION OF PIER BASE

other hard strata. A loading of 6 tons per square foot of surface (exclusive of buoyancy) was decided upon as safe. This required a diameter of base of about 14 ft. for the largest piers and bases of proportionate size for the smaller ones, with the pier bases covering about 40 per cent of the site. The piers were spaced 17½ ft. c. to c. in one direction and 21 ft. in the other, and therefore the bases would be only 3½ ft. apart in one direction, a situation which might lead to serious construction difficulties under the conditions prevailing. It was also found that more than one stratum of hardpan existed under the east half of the site. One stratum lay directly upon the rock, and above this there were often other strata, separated by layers or lenses of fine sand and clay. However, any of the hardpan strata was of sufficient thickness to sustain and distribute the loads, provided that the piers rested upon the surface and did not penetrate into the hardpan.

Belled Pier Bases—Taking into consideration all the factors of the problem it was decided to attempt to extend or bell out the excavation below the bottoms of the pier cylinders to a diameter sufficient to limit the gross load on the surface of the hardpan to 6 tons and to make the depth of the pier bases uniformly 7 ft. This work would have to be done at a depth of 40 to 84 ft. below high-tide level, and in the quicksand, soft clay or clean coarse sand overlying the hardpan. It was of course evident that it could be done only under compressed air, with pressures varying from 18 to 36 lb. per square inch, and that provision would have to be made to sustain the overhanging banks of the pier-base excavations and to hold the air pressure in these excavations. Furthermore the concrete cylinders had not been designed to sustain a bursting pressure equal to the pressures mentioned, and therefore the air pressure must be confined to the excavations to be made below the bottoms of these cylinders

To meet the last mentioned condition, steel working chambers were made to fit loosely within the concrete cylinders, each chamber being connected to a vertical steel shaft 30 in. in diameter. It was then lowered down into the well of a cylinder until the bottom of the working chamber was about level with the bottom of the concrete cylinder and the top of the shafting projected above the top of the cylinder. The steel shafting was then bolted to steel beams resting upon the top of the cylinder, an air lock was connected to the top of the steel shafting, and cast-iron weights were loaded upon the beams supporting the shafting, to overcome the lifting effect of the air pressure in the working chamber. Compressed air was carried down into the working chamber through a pipe outside of the steel shafting. The space between the working chamber and the inside surface of the concrete cylinder was closed by an expanding sectional wooden ring and calked with oakum. The sandhogs passed through the air lock, down the ladder inside the steel shafting, into the working chamber and thence into the excavation below. The excavated material was bucketed up through the working chamber and shafting into the air lock and thence out. The photograph Fig. 4 shows, at the left, the top of an air lock and the surrounding working platform.

The bottom of the concrete cylinder was blocked up from the floor of the excavation below. The side of the pier base excavation was supported by poling boards, about 3½ ft. long, held in place by sectional rings of steel angles (Fig. 4). These poling boards, plastered with clay, served to retain the air pressure,

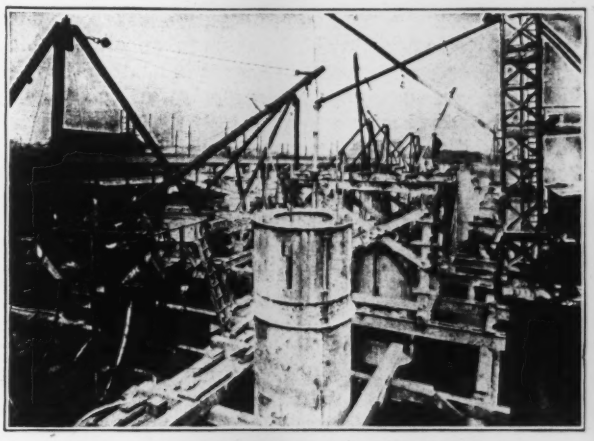


FIG. 4—COMPRESSED-AIR WORK ON PIERS

but in some instances the character of the soil (clean coarse sand) was such that the pressure was held with difficulty, in which case concrete sectional rings were cast in place as the excavation proceeded.

When the pier-base excavations were completed, they were filled with concrete passed down through the air lock and shafting, and the air pressure was maintained until this concrete had set, after which the pressure was released, the apparatus was lifted out of the wells and the wells were filled up with concrete.

The upper portion of the piers was heavily reinforced and the piers were connected together transversely by heavy reinforced concrete girders. A concrete sea wall rests upon the outboard line of piers and a concrete longitudinal girder connects the rear line of piers. The columns and girders of the building will bear directly upon the tops of the piers.

About a year was required to accomplish this work. The compressed-air work was in progress for about 5½ months of this time. Notwithstanding the considerable air pressure, maintained for so long a period of time, there were no fatalities, and only a few cases of caisson disease, which yielded readily to treatment. The work was done for the Standard Milling Warehouse Corp. under the direction of the A. E. Baxter Engineering Co. of Buffalo, New York, consulting engineers. The detailed plans for the execution of the foundation work were made and the work done by Jarrett-Chambers Co., Inc., of New York. The Lynch Construction Co., of New York, is the general contractor for the building.

New Sources of Water Supply for Philadelphia Recommended

Retiring Chief Advises Abandoning Present Intakes for Storage on Creek and Pumping from Delaware above Trenton

ABANDONMENT of the present Schuylkill and Delaware River intakes of the Philadelphia water-works for a new intake from the Delaware River above Trenton combined with 18- and 33-billion-gallon storage reservoirs on Neshaminy Creek, a tributary of the Delaware, is recommended by John C. Dunlap, chief of the Bureau of Water of Philadelphia, in his annual report for the year 1923. The estimated cost of a 600-m.g.d. supply from these sources is $60,000,000, and the supply would be ample for a population of 4,000,000, Mr. Dunlap states. Before summarizing Mr. Dunlap's recommendations it should be noted that since the date of Mr. Dunlap's report a new city administration has come into power. Alexander Murdock has been appointed chief of the Bureau of Water, and there is indication that the question of an additional water supply for Philadelphia will be examined anew.

Besides the two reservoirs already mentioned, Mr. Dunlap's plan includes a pumping station on the Delaware River with a capacity of 400 to 600 m.g.d.; a 600-m.g.d. "conduit" therefrom to the lower Neshaminy reservoir; an aqueduct of 650 m.g.d. to the branch aqueduct mentioned below and of 350 m.g.d. from the branch to the Queen Lane reservoir (which now stores Schuylkill River water); a 350-m.g.d. branch aqueduct to the present Torresdale filters and pumping station on the Delaware River; a 250-m.g.d. pumping station near the present Queen Lane station; a 100-m.g.d. high-service pumping station at Torresdale; various force mains to existing filter plants; gradual enlargements of the present Torresdale, Queen Lane, Roxborough and West Philadelphia filter plants; and a new 100-m.g.d. storage reservoir in the northeast part of the city. All the existing filters and all the pumping stations except those at Belmont and Roxborough would be retained, and the latter need be abandoned only because the work they do can be done more cheaply at other and larger stations.

As a reason for adopting this plan instead of the one recommended in 1920 by J. W. Ledoux and J. F. Hasskarl of Philadelphia, and George W. Fuller and J. Waldo Smith of New York, and endorsed by Carleton E. Davis (then and until June, 1923, chief of the Bureau of Water), Mr. Dunlap cites later B. Coli records as evidence that the pollution of both rivers was even in 1920 worse than the records then available indicated and that since then the pollution has increased. For "at least two years," Mr. Dunlap states, "the Delaware River water at Torresdale has, for the majority of the time, been more dangerous to health than the Schuylkill River water." In 1920, Mr. Dunlap states, practically all water samples from both rivers showed B. Coli at 1:10 dilution, making it necessary to use dilutions of 1:100 and 1:1000. Without stating the exact period covered, but evidently meaning within the past year or so, Mr Dunlap says:

> The results obtained from 1:1000 dilution samples from the Schuylkill River show positive results for about one-third of the total samples tested. Whereas in the Delaware River the number of positive results in the samples tested between May and October are about three time as high as those from the Schuylkill River for the same period, the B. Coli index for the remaining months is about the same for the two rivers. The net result is that there are about three times as many samples showing positive results from the B. Coli test from the Delaware River water in a year as from the Schuylkill River.

The 1920 report mentioned above (see *Engineering News-Record* Oct. 14, 1920, p. 751, for 3-p. abstract) recommended the ultimate abandonment of the Schuylkill and of the present intake at Torresdale on the Delaware for a semi-gravity supply project consisting of storage on Perkiomen, Tohickon and Neshaminy Creeks and pumping from the Delaware above Trenton, to give a supply of 500 m.g.d.; but of a proposed expenditure of $35,000,000 up to 1926 the board of engineers proposed that $10,000,000 be used in extensions and improvements to the existing Delaware and Schuylkill supplies, $17,000,000 for distributing mains, reservoirs, etc., and only $8,000,000 for water from a new source. Moreover the only portion of a new or changed supply to be included for immediate introduction was to be a "first impounding reservoir on Perkiomen Creek," etc., whereas Mr. Dunlap would go afield at once for the entire supply.

Summarized cost estimates for the various projects as made by the Bureau of Water [presumably since Mr. Dunlap took the place of Mr. Davis last June] are as follows, the estimates including "delivery conduits to the present pumping stations and filter plants:"

Source	Quantity	Cost
Perkiomen	160	$ 53,000,000
Perkiomen-Tohickon	250	71,000,000
Neshaminy-Delaware [recommended by Mr. Dunlap]	600	60,000,000
Neshaminy-Delaware-Perkiomen	690	70,000,000
Perkiomen-Tohickon-Delaware, with conduits to Queen Lane and Torresdale	600	107,000,000

Perkiomen water-right damages would be "very high," Mr Dunlap states.

Flexible Locomotives on Narrow-Gage Lines

Locomotives with flexible wheelbase on the Garratt system are being introduced to a considerable extent in Africa and India for narrow-gage lines having heavy grades and numerous sharp curves. The largest of these engines is a 97-ton locomotive of the 2-8-0-0-8-2 class, built in England recently for the meter-gage lines of the Burma Railway and it is the first engine of its type to have eight-coupled groups of wheels. In other types of flexible locomotives the main frame extends the full length of the locomotives and is supported on one fixed and one swiveling group of wheels, as in the Mallet engine, or on two swiveling groups, as in the Fairlie engine. The Garratt engine, however, has the boiler carried on a steel deck slung between two trucks, with pivot supports on the near ends of the trucks and the cylinders placed at the outer ends. Additional adhesion weight is given by tanks and coal bunkers on the trucks. In the engine for the Burma Railway the truck bearings are spaced 32 ft. 9 in. c. to c. and the total length is about 70 ft. The two end driving axles and the two groups of eight 39-in. driving wheels can adjust themselves independently on curves and the engine is designed to traverse curves of 250 ft. radius. On one truck is a 1,500-gal. tank and on the other is a 600-gal. tank and a 5-ton coal bunker. The weight averages 10 tons on each driving axle and 9½ tons on each of the two end axles.

From Job and Office

Hints That Cut Cost and Time For the Contractor and the Engineer

Cofferdam Built in Swift River on Rock and Boulder Bottom

By Frank T. Healey

Construction Superintendent, Chicago, Ill.

BIG FALLS in the Flambeau River is in reality a series of falls with long, swift rapids where the water runs about 14 ft. deep in a channel made up of granite ledges and boulders scoured so clean that there is no "toe hold" for sheetpiling. The new dam of the Lake Superior District Power Co. was to be built in one of these rapids, and on account of the character of the bottom it was necessary to devise means of closing the cofferdam other than the usual one of driving sheetpiling into the bottom. The plan adopted was as follows:

Timber cribs of the usual character for cofferdam work were built and floated into the channel where they were sunk in place by filling them with rock. Then along the outside a guide wale was drift-bolted to the top of the crib to use in measuring depth across the channel. When this was completed panels of Wakefield sheetpiling 10 ft. wide and made up of 2 x 10-in. stock of suitable length were made on shore. In the meantime the distance from the guide wale on the crib to the bottom of the channel at both ends of the point where the panel of Wakefield sheetpiling was to be placed was carefully measured and an approximate idea of the character of the bottom between the two ends obtained. The two end pieces of sheetpiling were then cut to suit this length and the top and bottom wales cut and bored and the whole panel bolted up as shown in Fig. 1.

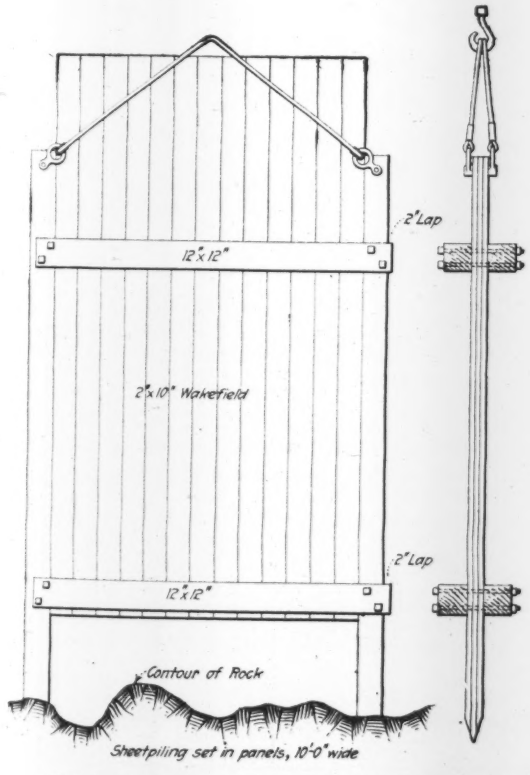


FIG. 1—DETAILS OF SHEETPILING PANELS

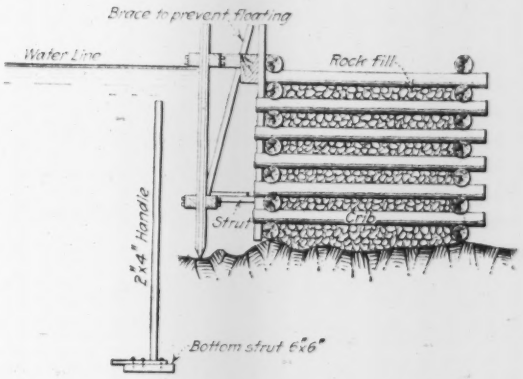


FIG. 2—METHOD OF SECURING SHEETPILING TO CRIBS

The friction between the wales and the intermediate pieces of sheetpiling held them in place while the panel was being swung out by means of a special hook and cable to its place in the cofferdam. The panel was then made fast and the end sheets were driven down until they made a good joint with the rock bottom. The ends of the top wales were then made fast to the crib wales and the intermediate pieces of sheetpiling driven down to the bottom and broomed so that each individual pile is down to a bottom independent of the adjoining pieces.

The difference between this section of cofferdam and a section of an ordinary cofferdam is that by building the cofferdam in sections it can be provided with a bottom wale which can be braced against the crib to make the bottom of the cofferdam secure against movement. This bottom bracing must be placed before the cofferdam is unwatered. To do this a pair of double-ended calipers with equal legs was lowered down inside the sheetpiling between it and the crib until it touched the bottom wale; then slipped out over the edge of the wale and lowered an inch or two below the edge where it was opened until the opposite leg came against an upright previously spiked against the side of the crib. As the caliper had equal legs it was possible to measure the distance between the wale and the upright on the side of the crib by measuring the distance between the upper ends of the legs. Next a strut of 6 x 6-in. material, with a cleat spiked to the top of it, as shown in Fig. 2, was lowered down into place by means of a wooden handle and set in between the wale and the side of the crib with the crib end lower than the end against the waling. The strut was then driven

into place with an iron rod until it "sounded" right. Following this, a piece of ½-in. pipe was let down on top of the cleat where it laps over the wale, a 60-penny nail was dropped down the pipe and driven home by a ¾-in. rod. When the panel was braced at the bottom a second brace, shown in Fig. 2, was placed on the lower wale to prevent its rising.

The construction of the rest of the cofferdam was a repetition of the above. After all the sheetpiling was in place and driven down as far as possible the bottom of the cofferdam was examined by feeling along with

FIG. 3—RIG FOR SETTING AND DRIVING COFFERDAM

an iron rod bent over at 90 deg. for about 2 in. at the lower end and the ledges, seams, and overhangs which were located in this way were plugged with small bags of earth. The cofferdam as built was 165 ft. long on one side and 175 ft. on the other, and when unwatered a 2-in. suction was sufficient to keep it practically dry.

The work was not expensive and was done by three men, one operating the derrick while the other two guided the panels into place and operated the 600-lb. steam sheetpile hammer. Sixty piles were placed in a 10-hr. day. The cofferdam when completed, including cribs, sheetpiling and labor, cost approximately $5,000.

Daily Bulletins Contain Data on Structural Stocks

By Alexander Peden
Draftsman, Dominion Bridge Co., Montreal, Canada

STOCK bulletins which can be made up, printed and mailed to salesmen within a very short time are often invaluable to dealers in structural shapes. With this idea in mind the writer devised the scheme herewith reproduced. It consists in making a permanent linen tracing showing all classes of material and lengths carried in stock while heavy pencil notations give quantities in stock. These figures can be easily and quickly changed from day to day.

During the busy season this bulletin is corrected and mailed each evening, thus giving designers and salesmen definite information. Such a service would be particularly advantageous in any business where material cannot be kept on hand in sufficient quantities to cover all possible requirements.

DOMINION BRIDGE CO — WEEKLY STOCK BULLETIN

BEAMS

CARNEGIE I BEAMS	STOCK 80	60	40	30	20	SHORTS	IN TRANSIT	ON ORDER
7"@ 57#			116			50		
7"@ 77#							120	
7"@ 96#						9		
5"@ 100#			117			6		
6"@ 125#		143	234	1		11	200	
6"@ 153#								

CARNEGIE H-BEAMS	STOCK 80	60	40	30	20	SHORTS	IN TRANSIT	ON ORDER
14"x14"@ 233#			159					
8"x8"@ 67#			275		2	33		
10"x10"@ 112#		156	243	22	5	26		
10"x10"@ 89#			11		1	9		
8"x8"@ 58#				13	18	65		
6"x6"@ 36#		1			1	8		
12"@ 279#	30	177		53	17	1	15	
12"@ 305#	015							

Stock lengths given vary from length given to length in next column
Corner stroke indicates lengths generally kept in stock
x-Cross indicates need of reference to special notes on page 3
re Rolling dates etc

ISSUED BY STOCK RECORDS DEPT.
4.30 P.M. November 13th 192_3

STRUCTURAL MATERIAL ON HAND

BETHLEHEM I-BEAMS, GIRDER BEAMS, COLUMNS, CHANNELS

BETHLEHEM I BEAMS	STOCK 80	60	40	30	20	SHORTS	IN TRANSIT	ON ORDER
7@ 20#	22		1	7	13			
10@ 25#	37	1	1	11	51			
12@ 35#	41			4	114			
320#					1			
360#	39	1		17	55			
14@ 38#			1	1	75			
410#					5			
460#	3	4		1				
540#					2			
18@ 48#		0		1	2			
520#		1		4	1			
570#				4				

BETHLEHEM COLUMNS	STOCK 80	60	40	30	20	SHORTS	IN TRANSIT	ON ORDER
14@ 84.6#	14		0	16	64			
820#	1		1	5	3			
1010#			4	4	13			
1075#			1					
1145#								
1300#			1					
1420#			2					
CHANNELS								
8"x 5"x 13.5#				1	23			
8"x 6"x 18.4#					13			
12"x 8"x 25#					1	3		

DAILY STOCK BULLETIN OF STRUCTURAL MATERIALS

From Job and Office

Hints that Cut Cost and Time

Cost of Safeguarding Workers on a 16-Story Building

THE MATSON Building, a 16-story office building on lower Market St. in San Francisco, was completed in December, 1923, without any fatalities or serious injuries to workers engaged in its construction. The building is 173½ ft. square and 317 ft. in height. The construction period extended over 19 months during which an average of 200 workers in 21 building crafts were employed. Sixty minor accidents occurred during the construction period for which compensation and medical fees totaled $6,841. In addition to this the cost of safety work was $12,900 or $64.50 per employee. An itemization of the expenditures for safety work follows:

Planking floors	$6,250
Guarding machinery	250
Guarding floor openings	
Guarding stairways	
Guarding 2 elevator cages	3,500
Guarding 2 elevator shafts	
Sidewalk canopy	1,350
Canopy on suspended scaffold, railings, toe boards and outside protection	750
Ladders and temporary stairways	800
Total	$12,900

The general contract for the building was held by Lindgren & Swinerton, Inc. J. J. Rosedale, who supplied the foregoing information, was safety engineer for the contractor.

From Job and Office

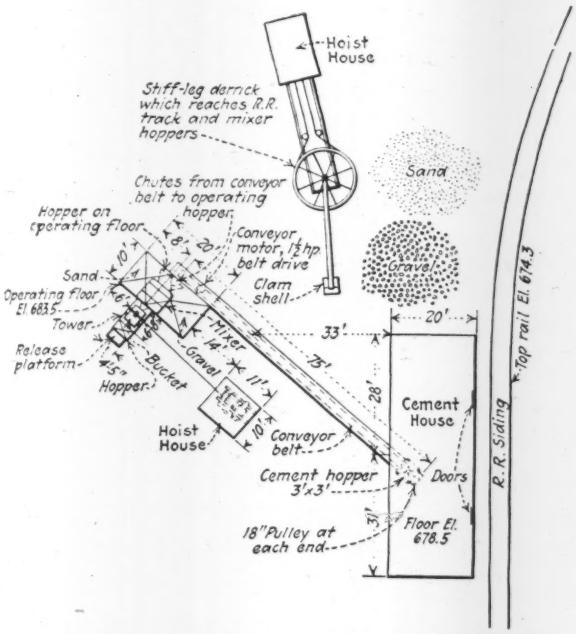
For Contractor and Engineer

Belt Conveys Loose Cement from Storage Shed to Mixer

By J. F. Laboon

Of the J. N. Chester Engineers, Pittsburgh, Pa.

LOOSE cement is moved by a rubber belt conveyor from the warehouse to the concrete mixer at the new water intake, pumping station and water filtration plant being constructed for the city of Wheeling,



CONCRETING LAYOUT ON FILTRATION PLANT JOB

W. Va., by the John F. Casey Co. of Pittsburgh, Pa., contractors for the substructure work, which involves some 10,000 cu.yd. of concrete.

The cement is delivered in sacks and unloaded by hand from the cars at the railroad siding directly into a cement house 20 x 60 ft. in plan. From the cement house the belt conveyor carries the loose cement 75 ft. to the concrete-mixer loading platform where it discharges in a chute leading to a gravel pocket holding a single charge to the mixer.

At the cement house the sacks are emptied into a 3-ft. square wood hopper located in the center of the cement house, holding enough cement for one mixer batch. The hopper rests directly over the belt conveyor. The operator at the concrete-mixer charging platform controls the movement of the cement belt conveyor by means of a switch located overhead. The ordinary operation is to fill the mixer hopper with the proper amount of cement and gravel; then, by throwing in the switch, the conveyor carries the cement from the hopper in the cement house, and discharges it into the gravel hopper leading to the mixer. In the meantime the concrete mixer has been mixing the concrete so that no time is wasted in waiting for materials. The operating platform over the concrete mixer is 5 ft. higher than the platform in the cement house. The conveyor is operated by a 1½-hp. belt-driven motor and protected on the windward side by weather siding.

Originally the belt conveyor was used for transporting the cement in sacks but this was later abandoned since it was necessary to handle the sacks again at the mixer charging platform, whereas with the present scheme the cement in bags is handled but once, and the sacks do not leave the cement house where they are stored.

Operations have been conducted without cold-weather difficulties up to the close of December. Dust from the unloading chute at the mixer has caused no serious difficulty.

Finding Volume of Wing Abutments

By Charles L. Moore

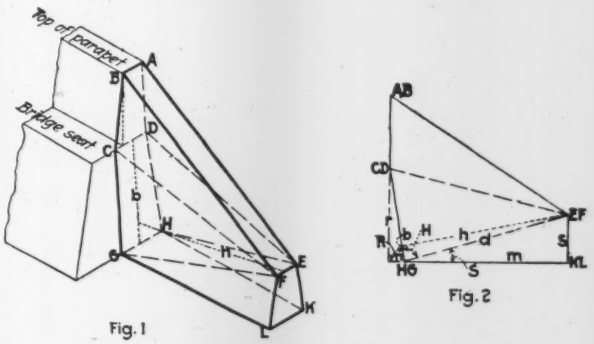
Civil Engineer, Fellows, Calif.

IN COMPUTING neatwork volume of the wing of a straight wing abutment of the general type shown in Fig. 1 herewith, it is convenient to divide the figure into three truncated triangular prisms; *ADEFCB*, *DEHGCF* and *HEKLGF*, and to compute the volume of each by the familiar formula:

$$\text{Volume} = \frac{SA}{3}$$

in which S = the sum of the parallel edges and A = the area of the plane section perpendicular to the edges.

The lateral edges of these three truncated triangular prisms can be readily drawn off the plans, or, the batters being known, easily computed from actual measurement of the completed structure. Likewise, the base and altitude necessary for computing the triangular areas of the right sections are known in the case of the upper and lower prisms *ADEFCB* and *HEKLGF*. However, in the case of the central prism *DEHGCF* the base b is known but the altitude h is not. This value of h may be determined by the solution of two right triangles



PROCESS FOR DETERMINING WING VOLUME

and the functional determination of a third angle, requiring several trigonometric operations. In order to avoid so much computation the following formula was derived giving the area of the right section direct.

$$\text{Area, } A = \tfrac{1}{2}(sn + mr)$$

in which s, n, m and r have the values indicated in Fig. 2 and can be taken from the plans. This formula is particularly easy of solution on a Monroe or other calculating machine.

An analytic derivation of the above formula follows.

$$A = \tfrac{1}{2}bh$$
$$h = d \times \sin H$$
$$\sin H = \sin\,(180^\circ - S + R)$$
$$= \sin\,(S + R)$$
$$= \sin S \times \cos R + \cos S \times \sin R$$
$$= \frac{s}{d} \times \frac{n}{b} + \frac{m}{d} \times \frac{r}{b}$$
$$= \frac{sn + mr}{bd}$$

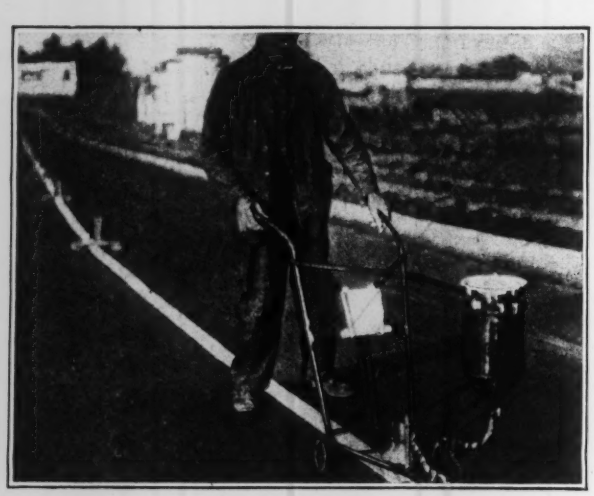
Therefore, $h = d \times \dfrac{sn + mr}{bd} = \dfrac{sn + mr}{b}$

and $A = \dfrac{sn + mr}{2}$

The above formula may also be proven geometrically.

Home-Made Device Paints White Stripe on Road Center Line

DIVISION 4 of the California Highway Commission comprises a number of main trunk highways approaching San Francisco on which the traffic is very heavy and on which it has been found helpful to keep the center line of the pavement marked with a white stripe. Painting these stripes by hand, which was the method used at first, was slow and laborious. A device was therefore built up in one of the division maintenance yards with which the striping was done with a wheeled frame carrying a brush fed from a paint tank supported on the frame above. This device had many deficiencies but it demonstrated that the plan was workable and its use suggested improvements that would greatly increase its efficiency and



A WAY TO SAVE TIME IN STRIPING PAVEMENT

usefulness. Taking advantage of the ideas that grew out of experience with this first device a second was built with which excellent results have been attained.

In the later machine, shown in the accompanying illustration, the frame consists of a single piece of ½-in. pipe bent somewhat in the shape of plow handles and attached at its lower portion to two axles which carry three ball-bearing rubber-tired wheels. Bracing and support for a 2½-gal. tank were made up from ⅛x¾-in. strap iron riveted to the pipe in such a way as to give a frame of the necessary rigidity. The tank is offset enough to give the operator a clear view of the center line ahead. Two ordinary painter's brushes 3 in. in width are used for applying the paint. They are clamped one behind the other and about 2 in. apart to a metal strap which is hinged to the frame at its forward end. This hinged support makes the contact between brushes and pavement independent of slight irregularities over which the wheels may pass. Another advantage of this hinged connection is that the brushes can be lifted off the pavement when the device is moved to the roadside or is drawn back a few steps to retrace an imperfect section.

A shallow pan is provided to carry the brushes when the device is moved off the center line. The pan has metal straps projecting from the four corners which fit on the frame and when the device is to be taken out of service, even though only for a few minutes, the brushes are raised, the pan is placed beneath them resting on the frame and the brushes are lowered into it. This takes care of the drip from the brushes which would otherwise smear the pavement. When not in use the pan is hung on the frame bracing as shown.

The paint feeds by gravity from the funnel-shaped bottom of the tank through a hose which passes through a hole in the bristle base to the center of the leading brush. At the tank the hose is ½ in. in diameter reducing to ¼ in. near the brush. Flow is controlled by a valve in the bottom of the tank.

An important feature of the brush arrangement is a U-shaped metal strap supported from the brush lever and just clearing the pavement. This is adjusted with the parallel side of the "U" containing the bristles of the two brushes near the pavement, thus preventing the bristles from spreading and insuring a stripe of uniform width.

The traffic paint used dries in about 15 minutes and thus only a few flag standards are required. The usual procedure in painting a considerable length of stripe is to use a motor truck which carries all materials and equipment and moves slowly along the center of the road ahead of the painting device. Four men are used, one to drive the truck, one on the paint machine, one to put out and retrieve the flag standards over fresh paint and one to walk ahead of the truck and enforce the "keep to the right" rule.

On straight runs the progress with this device is normally about 750 ft. per hour allowing for adjusting the paint flow and other delays. The device is now used for painting center lines at important intersections and gives a smoother and neater job than could be secured by the slower hand method.

From Job and Office

Hints that Cut Cost and Time

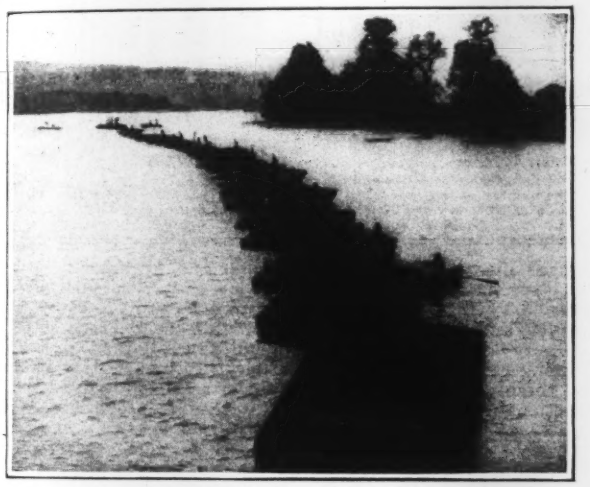
From Job and Office

For Contractor and Engineer

Laying Dredging Pipe Line Under Deep Ship Channel

IN DEEPENING the channel of the Columbia River near Walker Island at the mouth of the Cowlitz River, the Port of Portland Commission discovered it could dispose of some 1,235,000 cu.yd. of dredged material to the Long Bell Lumber Co. in its civic development at Longview, Wash. As dredging was on the Oregon side of the channel, crossing of the ship channel, accomplished by submerging the pipe, was necessary. Laying of the pipe was done as follows:

On the Oregon side of the river there was driven a landing stage of six piles protected by two dolphins. The 30-in. pipe was then assembled on the ordinary

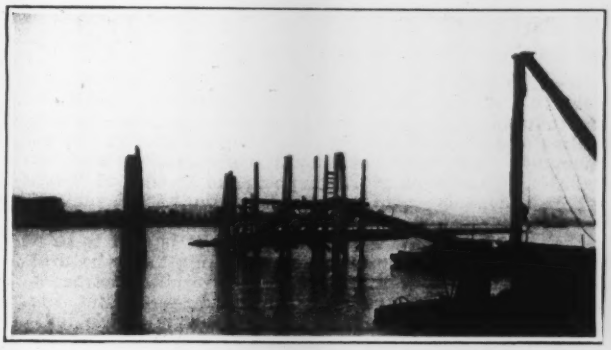


TOWING PONTOONS WITH SUBMERGED PIPE TO POSITION

pontoons, one pontoon to each 32-ft. section of pipe, alternate connections being flexible rubber sleeves. A wire cable, running back to a snubbing post on each pontoon, was then fastened to the center of each length of pipe, and two 40-ft. wire cables, one at each end of each length of pipe, were fastened to the pipe and to a ¾-in. wire cable long enough to reach across the river.

Beginning at one end of the string of pipe, a derrick barge lifted each length, its pontoon being then slid out from under it. The pipe supported by the cable on the pontoon was left hanging just in the water. This having been done to each pontoon, the cables on the pontoons were then simultaneously slacked and the pipe lowered 5 ft. into the water. A tug was then made fast to one end of the string of pontoons and they, together with the submerged pipe, were towed across the river, the pontoons anchored and drawn into line and the pipe lowered to the bottom of the river. The derrick barge then raised one end of the string of pipe with its 33-deg. elbow and 64-ft. length of riser pipe onto the landing stage. Connection was then made with the dredge and with other sections of pipe on pontoons and light trestles running to the area to be filled.

Before the pipe was submerged a dragline was used on the bed of the river where the pipe was to rest to clear it of any snags or large obstructions. No difficulty was experienced in laying the pipe, the channel being obstructed for only 20 minutes. The length of pipe necessary to carry out the filling varied from 3,300 to 6,900 ft.



LANDING STAGE FOR 30-IN. PIPE LINE

The work was done under the supervision of the chief engineer of the Port of Portland, J. H. Polhemus, with R. W. Nelson in charge.

Job and Office Notes

When Plotting Vertical Curves on profile sheets, it is necessary to determine the proper degree to use, when the length of curve and the algebraic difference in grades are given, writes J. LeRoy Underhill, inspector, Vermont Department of Highways. He continues: "Harger and Bonney, in their 'Highway Engineers' Handbook,' give a table of vertical curves with their corresponding radii. The formulas given below, however, do away with the interpolating made necessary by the use of tables, and are quickly solved on the slide rule. When the degree of curve is required: $D = \frac{1.43A}{L}$; in which D = degree of curve; A = algebraic differential in grades; L = length of curve in 100-ft. stations; and 1.43 = a constant. If the radius of the curve is desired: $R = \frac{40\,L}{A}$; in which R = radius of curve; 40 = a constant; and L and A have the same significance as in the preceding formula. In this case, the radius is given in stations of 100 ft. These formulas, which are presumably new, were derived by I. A. Holder, of the Vermont Highway Department."

Several Refinements in Design in the earth-boring machine, used particularly for post-hole digging for telephone, telegraph and light transmission lines, are incorporated in the new equipment recently placed on the market by the Four Wheel Drive Auto Co., which firm has acquired rights of manufacture and sale of this equipment from the International Earth Boring Machine Co. Manufacturers of the new earth-boring machine maintain that a crew of but two or three men, which includes the driver of the auto upon which the auger is mounted, can dig as many holes and set as many poles in a day as a crew of sixty laborers, working with hand tools.

Letters to the Editor

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

Earthquake Accelerations Computed From Overturned Objects

Sir—The very informing article of R. E. J. Summers in your issue of Dec. 27, summarizing conclusions based on the study of earthquakes, includes a reference to the calculation of horizontal accelerations from the overturning of columns in cases where seismograph observations are not available. The formula given appears to be that of West, of which some account may be found in "A Manual of Seismology," by Charles Davison, Sc.D., published in 1921. In that excellent work the estimated result is said to be a *minimum* value, as under conditions relating to the natural period of vibration of the column when rocking, the acceleration may be greater than the calculated result. But it is not there stated, nor does the writer of your article indicate that the true acceleration may be much less, as the following considerations will show.

Assumptions made are that there is pure horizontal motion only, and that the column if overthrown will turn about its extreme edge. Crushing of the edge may, however, bring the turning point nearer to the centre of the base. There may be a smart "drop" of the column base, which by reducing the stability moment would affect the result, and, further, the base may tilt in such manner as still more to lessen the resistance to overturning. If these adverse influences act all together, a very small horizontal acceleration rate may induce the column's fall.

We may, then, have conditions which will make the rate of acceleration corresponding to overthrow either greater or less than the calculated result in a material degree, rendering that result of no value. Acceleration rates deduced from fallen columns should therefore be treated with grave suspicion.

W. H. THORPE,
Civil Engineer.

London, Jan. 11, 1924.

Missouri Towns Increase Bond Issues for Water-Works and Sewers

Sir—We note from your issue of Jan. 3 that throughout the country state and municipal bond issues declined in 1923. In Missouri the contrary is true.

The enclosed exceprt from the annual report of George W. Putnam, state sanitary engineer, with data on bond issues for water and sewerage systems passed in Missouri (exclusive of St. Louis and Kansas City) shows that in 1923 no less than 32 towns issued bonds, the total being $2,607,000. The corresponding figures for 1902 were 22 towns and $1,869,000 and for 1921, 14 towns and $593,000. Reasons for the increase in municipal bond issues for sanitary improvements in Missouri are, we believe: (1) Increase in bonding limits to 10 per cent assessed valuation for water-works, light and ice plants, and to 5 per cent for sewers and other city debts; (2) the favorable market for municipal bonds; and (3) the active encouragement of these improvements in the last two years by the State Board of Health.

CORTEZ F. ENLOE, M.D.,
State Health Commissioner.

Jefferson City, Mo., Jan. 19, 1924.

[The following extract from Mr. Putnam's memoranda on the accompanying table of bond issues illustrates a need for sanitary improvements that is presumably common to many small towns in Missouri and other states:

"In one town with water-works but no sewerage system, diarrhœa and colitis were prevalent through the summer, causing the death of several babies. The sewage from residences having bathrooms overflowed from cesspools and septic tanks, due to the tight soil, into street gutters and alley ditches, with resulting offensive stench during warm weather and spread of infection by flies. The majority of the outdoor toilets serving the balance of the residences were of the open back surface type. Odors from these caused discomfort to the neighbors, and filth from them was spread by the rains to shallow water supplies and carried by flies to food in stores and homes. A sanitary survey and talk at a mass meeting, made on request of the city authorities, assisted in unifying all factions, and forcing realization of the toll of sickness and death caused by these conditions. Aroused public sentiment caused the election for these improvements, though previously defeated, to be passed by a majority of nine to one."

Surely bond issues to do away with such unsanitary conditions cannot rightly be classed as instances of "municipal extravagance," a term loosely used of late in the campaign to secure a constitutional amendment permitting the levying of a federal income tax on municipal bonds.—EDITOR.]

MISSOURI TOWNS VOTING BONDS FOR WATER-WORKS AND SEWERS IN 1923

Compiled by State Board of Health of Missouri, Division of Sanitary Engineering. St. Louis and Kansas City not Included.

City	Majority Vote	Amount and Purpose	Pop. 1920
Cameron	2:1	$57,000 W	3,248
Cameron	2 5:1	46,000 S	3,248
Canton	5:1	20,000 W	1,949
Canton	4:1	60,000 S	1,949
Carrollton	2 3:1	50,000 S	3,218
Carthage	4:1	110,000 S	10,068
Chamois	9:1	18,000 W	700
Chamois	9:1	12,000 S	700
Edina	2 9:1	60,000 W	1,438
Edina	2 6:1	60,000 S	1,438
Farmington	27:1	15,000 W	2,685
Farmington	8:1	85,000 S	2,685
Festus	55:1	101,000 W	3,348
Festus	55:1	74,000 S	3,348
Fulton	14:1	50,000 W	5,595
Gallatin	8:1	35,000 S	1,747
Greenfield	2 6:1	17,000 W	1,440
Greenfield	2 5:1	43,000 S	1,440
Hannibal	8:1	400,000 W	18,950
Harrisonville	9:1	60,000 S	2,073
Holden	4:1	68,000 W	2,011
Jasper	5:1	35,000 W	766
King City	2:1	70,000 W	1,150
Kirksville	4:1	260,000 W	7,213
Kirkwood	5:1	105,000 W	4,422
LaGrange	6:1	1,000 W	1,114
Lathrop	16:1	20,000 S	1,100
Lathrop	18:1	60,000 W	1,100
Maitland	2 3:1	20,500 S	716
Marceline	10:1	20,000 W	3,760
Marceline	7:1	55,000 S	3,760
Neosho	3:1	65,000 S	3,968
Odessa	2 3:1	15,000 W	1,786
Ridgeway	3:1	45,000 W	812
Ridgeway	3:1	45,000 S	812
St. Clair	11:1	10,000 W	442
St. James	12:1	33,000 W	1,117
St. James	11:1	12,000 S	1,117
Salisbury	9:1	50,000 S	1,757
Unionville	10:1	80,000 S	1,765
University City	8:1	136,000 S	6,792
West Plains	5:1	25,000 W	3,178
Willow Springs	4:1	3,600 W	1,441
Total		$2,607,000	

W stands for water-works and S for sewers.
The number of separate towns listed is 32. In 1922 there was a total of $1,869,000 bonds voted by 22 towns. In 1921 the figures were $593,000 and 14.

Promiscuous Contract Bonding

Sir—In the article by H. H. Wilson on questions relating to surety bonds, appearing in *Engineering News-Record*, Jan. 10, 1924, p. 68, the evils of promiscuous bonding are referred to.

Within the past year there have been two contractors on work under this department who have started work under bonds executed by well-known surety companies but have been unable to finance the work for even the first month. The loss to these two surety companies was about $30,000. There is no doubt but that the most superficial investigation would have disclosed the financial weakness of both contractors. They were both out-of-town concerns and the assurance of the bonding company's representatives that they were reliable was accepted in awarding the contracts, one an original contract and the other a sub-contract.

It is evident to anyone familiar with the letting of contracts that irresponsible contractors are frequently bonded at great risk and loss. The cost of bonds must necessarily be affected by this practice and it would be very helpful to the engineer and to the responsible contractor if surety companies would exercise greater care in ascertaining the standing of bidders before issuing bonds.

E. G. BRADBURY,
County Sanitary Engineer, Franklin County, Ohio.

Columbus, Ohio, Jan. 18, 1924.

News of the Week

CURRENT EVENTS IN THE CIVIL ENGINEERING AND CONTRACTING FIELDS

Chicago Engineers Discuss Local Transportation

Western Society Devotes Entire Convocation to Discussion of Perplexing Problem

Co-ordination of the various local transportation facilities of Chicago as a necessary factor in the improvement of the city's transportation system was urged at the mid-winter convocation of the Western Society of Engineers on Feb. 6 and 7, which meeting was devoted entirely to this problem. Various phases of and possible improvements in this system were discussed. City politics and sectionalism were given as among the reasons for lack of progress, any project developed for the benefit of the community as a whole being opposed by sections not directly interested or benefited. Since opposition is loud and approval is silent, aldermen are apt to give heed to the former.

Subways were advocated, but although numerous plans and reports have been made for years past, no action has been taken. At the dinner which closed the meeting, the mayor expressed the opinion that subways were still remote. Electric elevated and interurban lines and the surface lines were dealt with in separate papers. Traffic problems in regard to private automobiles, cabs and buses were also presented by representatives of these means of transportation.

Pedestrian Traffic

In reviewing pedestrian traffic conditions in the loop or congested business district, H. E. Young, engineer for the Chicago Plan Commission, suggested various improvements, including corner curves of wide radius, regulation of people at street crossings, two-level streets, elevated and subway sidewalks, elevated street-car tracks, arcade sidewalks at street or second-story level, arcades through corners of buildings at street intersections and elevated sidewalks in alleys. Plans for elevated and subway sidewalks were presented by J. H. Sawyer, city bureau of engineering, and T. L. Condron, respectively. But in discussion doubt was expressed whether the public would make much use of such facilities, involving stairways.

Suburban traffic on the several Chicago steam railroads was outlined by F. E. Morrow, assistant chief engineer of the Chicago & Western Indiana R.R. He pointed out that with one exception the railroads are not able to operate this traffic to advantage, since it must be handled on the same tracks as main line trains and there is no room for additional tracks. The exception is the Illinois Central R.R. with right-of-way wide enough for multiple tracks, and Mr. Mottier, of this road, outlined the proposed electric service. This will include special trains which will run express to certain transfer points and there be diverted to continue the run on local tracks, so that passengers at outlying sections will have express service without changing cars. Most of the railroad engineers in discussion agreed that it would not pay to spend large sums in developing local traffic which pays such a small return. Mr. Kelker suggested connecting the city rapid transit lines with the suburban lines of main railways, as is done in London.

A set of recommendations as to desirable improvements was submitted by the society's committee on local transportation, and was referred back to the committee for final revision in the light of the views presented at the meeting.

Canadian Road Conference Called

The tenth annual conference on road construction for Canadian county and township road superintendents and engineers will be held in Toronto, Ont., Feb. 25 and 26. Immediately following the conference there will be held the annual meeting of the Canadian Good Roads Association.

Progress on 5-Ft. Water Pipe to Serve San Francisco

Steady progress has been made on the 20 miles of 5-ft. pipe which the City of San Francisco is building down the peninsula and across the lower end of San Francisco bay and it is now estimated that the additional water supply to be brought through this line will be available Jan. 1, 1925. This pipe is to be used for Spring Valley water until a conduit can be built to convey Hetch Hetchy water across the San Joaquin Valley. The agreement with the Spring Valley Co. under which the peninsula pipe is being built was announced in *Engineering News-Record*, May 4, 1922, p. 751.

On Jan. 25, about three-quarters of the 10 miles of pipe between the bay crossing and Pulgas tunnel has been laid in trench and backfilling was to start as soon as final pressure tests had been made and the pipe accepted from the contractor. Concrete lining in the tunnel which is 8,675 ft. long, had been completed except for the invert, and foundation work on the 6,400 ft. bay crossing was well under way. This crossing will consist of thirty-six 105-ft. steel trusses supported on concrete piers and a channel about ½-mile wide which will be crossed by ball-and-socket pipe lying on the bottom. The steel trusses are designed to carry two 76-in. steel pipe lines, which it is anticipated will be the ultimate loading, although only one 60-in. line is to be put in now. Excavation of the trench across the 9 miles of lowlands east of the bay crossing has been started and will be carried on as rapidly as weather conditions permit.

Water Admitted to World's Longest Tunnel

18.1-Mile Shandaken Bore of Catskill Aqueduct Received Flow of Schoharie Creek Last Week

Marking the initial step in placing in service the world's longest tunnel, water was admitted to the Shandaken bore of New York City's Catskill aqueduct near Grand Gorge, N. Y., for the first time on Feb. 9. Work on the tunnel, which extends through rock a distance of 18.13 miles, exceeding the length of the Simplon tunnel through the Alps by 5.8 miles, was begun in the fall of 1917 with a time schedule of 8 years and involves a cost of $12,300,000. Its function is to carry water diverted from Schoharie Creek by the Gilboa dam into the Ashokan reservoir of the $185,000,000 Catskill water supply system, whence the flow is by gravity to New York City, a total distance of 156 miles. The tunnel is concrete-lined and has a finished horseshoe shaped section 10 ft. 3 in. wide and 11 ft. 6 in. high. Its slope is 4 ft. 5 in. per mile and its carrying capacity 600,000,000 gal. in 24 hr.

Construction Features

Construction involved the sinking of seven shafts ranging in depth from 320 to 630 ft. and spaced at intervals of about 2 miles. Only 12 headings, however, were worked simultaneously, the maximum combined monthly advance occurring in February, 1922, when a progress of 6,040 ft. was recorded.

In drilling the headings about 30 holes 10 ft. or more in length were put in for each round. In all, the drill holes aggregated more than 3,000,000 ft. in length and the blasting explosives used totaled 500,000 lb. For the tunnel lining 425,000 bbl. of cement were used.

The entire tunnel job was electrically operated, power being transmitted over a specially built high-voltage power line extending 48 miles from Kingston, N. Y.; the total power consumption was about 25,000,000 kw.-hr. for the operation of air compressors to run the drills, for moving the tunnel trains, hoisting and lighting the bore.

The district lies a good many miles from the industrial labor centers, and it was necessary to bring in practically all labor from outside. Motor buses were used extensively in transporting groups of men gathered in labor centers as far away as Buffalo. The labor force ran about 1,200 to 1,600 men and represented almost every nationality. The men were housed in special quarters built near each shaft, for the most part 28-man houses divided into rooms for two men each.

During its early stages, the work fell considerably behind the scheduled progress because of scarcity of labor and mounting prices. The contractor

(*Continued on p. 299*)

Colorado River Problem Again Live Issue

Swing-Johnson Bill Hearings Begin—Secretary of Interior Finds Position Embarrassing

Washington Correspondence

The Colorado River situation will not down. Some months ago the Federal Power Commission washed its hands of that perplexing problem by refusing to grant any license for power development on that river until a further opportunity to get together had been given the states in its basin. While this action is alleged to have done a great injustice to James B. Girand, who has certain moral, if not legal claims on a license for the development of the large project at Diamond Creek, it has not prevented the cropping up of the problem from the different quarters.

The Secretary of the Interior was principally responsible in his capacity as a member of the Federal Power Commission for the refusal of a license to Mr. Girand, and with the new appearance of the problem Secretary Work finds the whole matter in his lap. The Swing-Johnson bill is before the House committee on arid lands. Several weeks ago the committee decided to begin hearings on the bill. It was found that Secretary Work had not reported on the measure and he showed a disinclination to make such a report. Finally a delegation consisting of W. B. Mathews, special attorney for the city of Los Angeles; J. R. Carr, representing the city of Pasadena; Mark Rose, representing the Imperial Valley Irrigation District; T. Yager, representing the Coachella Valley Irrigation District, and others interested in the construction of the Boulder dam, which is provided in the Swing-Johnson bill, called upon Secretary Work. The Secretary declined to make any promise as to when he would report on the matter. The attention of the White House then was brought to the matter and Secretary Work countered by appointing a committee to advise him as to how best to handle the Colorado River situation. As this is written, the advisory committee is sitting and it is understood that the report on the bill soon will be in the hands of the committee.

Secretary Work's Quandary

Secretary Work is subjected to a double embarrassment in this situation. He is anxious to further the policy of the upper states of the basin, which is to allow no development on the river until the policy of utilization is agreed upon. In addition, he is not particularly desirous of adding his endorsement to a project urged so strongly by A. P. Davis and regarded as one of his principal conceptions. At the same time to report against the Boulder dam carries with it the promise of distasteful consequences.

Prospects seem to favor an equal division of the members on Secretary Work's advisory committee. Chief Engineer Weymouth and his assistants, W. R. Young and E. B. Debler, also members of the committee, apparently will urge the approval of the Boulder dam. Col. William Kelly, chief engineer of the Federal Power Commission; Herman Stabler, of the U. S. Geological Survey, and Col. Spencer Cosby, of the Corps of Engineers, are expected to report against the Boulder dam. Some are of the opinion that the Secretary will return the bill without recommendation with the reports of these two elements in his advisory committee.

Baltimore to Build Two Refuse Salvaging Plants

Two refuse salvaging plants are proposed for the city of Baltimore. According to information received from Steuart Purcell, chief engineer, Department of Public Improvements of Baltimore, the two salvaging plants will be substituted for five incinerating plants without salvaging features that had been previously proposed. Mr. Purcell states that the decision to make this change was the result primarily of the successful operation of the refuse salvaging plant at Washington, D. C., where "tin cans, bottles, scrap metal, etc., which are difficult to dispose of by incineration," he observed, "could be salvaged and sold at a profit, and that the profit from the sale of waste paper and rags alone was sufficient to make the establishment of such a plant worth while."

Tunnel Reopened after Fire that Destroyed Timber Lining

The timber lining in tunnel No. 1 on the Southern Pacific R.R. main line in the Sacramento Valley caught fire last May and caused the caving in of the tunnel. The line was closed for eight days while a temporary track was built around the tunnel, and during this time passengers, mail and express were transferred between trains that stopped at opposite ends of the tunnel.

All trains used the temporary track until Jan. 25 when the tunnel was opened to traffic after having been cleared and lined with concrete. The length of the timbered tunnel which was 435 ft. was reduced in the relining process to 369 ft. The placing of concrete lining in other tunnels on this line is contemplated.

To Finance New Niagara River Crossing

The Interstate Commerce Commission has authorized the American Niagara Railroad Commission to issue $1,000,000 common capital stock to be sold to the New York Central and the Canadian Pacific R.R. Co. The proceeds are to be used in the construction of a line from a connection with the New York Central R.R. at or near Tonawanda, N. Y., across Grand Island in the Niagara River to the international boundary line, a distance of about 10.36 miles. The Canadian Niagara Bridge Co. will take over construction at this point and continue the line to a connection with the Michigan Central at Welland, Ont., thus establishing a new connection between railroads on the American side of the Niagara River and those on the Canadian side. The total cost of the undertaking is estimated at $18,000,000.

Deepening Hudson to Albany Proposed by Legislature

Asks Congress for Appropriation for Work—Army Engineers Oppose Project

The New York State Legislature has passed the Byrne-Doyle resolution memorializing Congress with regard to an appropriation for dredging the Hudson River to a depth of 27 ft. from the Hudson to the federal dam at Troy.

Lieut. Col. J. R. Slattery recently made an unfavorable report on this proposition to deepen the Hudson on the ground that there was insufficient evidence that the creation of a port at Albany at such great expense would produce savings in transportation costs to warrant the outlay. His conclusions were as follows:

"(1) The expense of improving that part of the upper Hudson between the Albany-Greenbush Bridge at Albany and the dam at Troy would cost approximately two and one-half times as much as the improvement from Hudson to Albany.

"(2) Even if a twenty-seven-foot channel were provided to the so-called Capital district, it is by no means certain that existing business customs and trade channels could be so modified by business interests in the Capital district as to create a use of the proposed channel commensurate with its cost.

"(3) Until the possibility of creating a successful port in the Capital district has been demonstrated and the savings in transportation costs, estimated as likely to result therefrom, verified, that part of the proposed improvement between Albany and Troy should not be undertaken.

"(4) Deepening the river between Albany and Troy is not essential at this time in order to confer upon all the cities and towns naturally making up the Capital district port the benefits to be expected from a port."

Lieutenant Colonel Slattery's announcement concluded with the notice that interested parties could appeal from the findings to the Board of Engineers for River and Harbors at Washington. For proper presentation appeals should be mailed within four weeks.

Minnesota Metropolitan Planning Committee Organized

A Metropolitan Planning Committee to serve an area of 25 miles in radius, using the present center of population of Minneapolis and St. Paul, was organized on Jan. 10. Among the officers are the following: President, Edwin H. Hewitt; vice-president, Aaron M. Burt, assistant to the vice-president of the Northern Pacific Railway Co.; secretary, W. Y. Chute, Minneapolis Real Estate Board. The executive committee consists of the president, vice-president and secretary together with A. C. Godward, city planning engineer of Minneapolis, and G. H. Herrold, city planning engineer of St. Paul. The idea of forming a Metropolitan Planning Committee was launched by the Northwestern Section of the American Society of Civil Engineers.

New York Road Builders Meet

Two hundred and fifty road contractors and their guests were present at the seventeenth annual banquet of the New York State Road Builders Association held at the Hampton Hotel in Albany on Feb. 5.

The speakers included Col. Frederick S. Greene, commissioner of public works of the State of New York; Senator James J. Walker; H. H. Wilson, vice-president, Zone No. 2, of the Associated General Contractors; and Benjamin P. Wheat, counsel of the New York State Road Builders Association.

In his address Colonel Greene emphasized the economic loss involved in contractors bidding too low for the state highway work and pointed out that this loss is felt not only by the contractor but also by the community.

Minority House Committee Report Opposes Ford Offer

Emphatic opposition to the acceptance of Henry Ford's bid for the Muscle Shoals property, as contained in the McKenzie bill reported out to the House last week by the Military Affairs committee, is contained in a minority report of that body submitted Feb. 9. The minority report asserts acceptance of Ford's bid would amount to "a gift of enormous property and industrial advantage to a private citizen from the resources of the United States." Contention is made that no definite commitment has been voiced by Ford or an accredited representative as to whether he would accept the properties offered him in the pending bill.

Greatest opposition to Ford's proposal is apparent in the minority report's statement that the $5,000,000 the Detroit manufacturer offers would include properties which cost the government $83,000,000. Any of the other offers is better than the Ford bid, the minority holds, adding that benefits he asks "has led his supporters to strange arithmetical gymnastics."

Flathead River Studies Made

To determine the potential power and storage available on the South Fork of Flathead River, Montana, the Interior Department has detailed an engineer of the Geological Survey to make a reconnaisance to ascertain whether or not a feasible site for a dam could be found along the lower reaches of the river. A site was found where a dam 350 ft. high would create a reservoir having a capacity of 1,320,000 acre-ft. A mean effective head of 280 ft. could be obtained at the reservoir, which would make potentially available more than 90,000 hp. A manuscript report has been prepared which describes the dam site and presents the technical data upon which the conclusions are based.

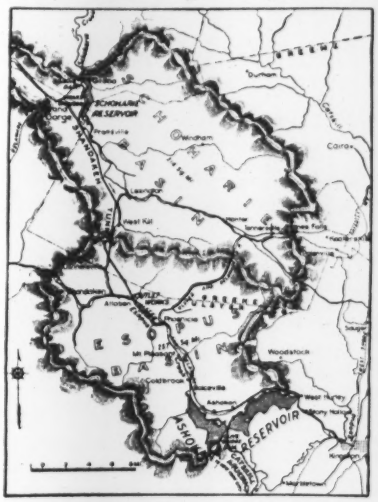
In order that data on the potential power of streams examined by the Geological Survey may be made of greatest use to those who are interested a copy of this report will be sent on request to the office of the district engineer nearest the applicant, where it may be consulted.

Admit Water to Longest Tunnel

(*Concluded from p. 297*)

ran into financial troubles and the work was taken over by a new corporation.

The Shandaken tunnel was constructed under the plans, specifications



TUNNEL PIERCES DIVIDE BETWEEN SCHOHARIE AND ESOPUS WATERSHEDS

and supervision of the Board of Water Supply of the City of New York. The project was begun under the direction of J. Waldo Smith, for many years chief engineer of the board and at present its consulting engineer. Thaddeus Merriman is now chief engineer

CONCRETE-LINED SECTION OF 18-MILE SHANDAKEN TUNNEL

and George G. Honness department engineer in direct charge of the work.

The contractor is the Shandaken Tunnel Corporation, formed and financed by the National Surety Co. of New York, the Fidelity & Deposit Co. of Maryland and the Ulen Contracting Co. All of the tunnel work was under the direct charge of Thomas S. Shepperd, senior vice-president of the Ulen organization. Merton R. Keefe is general superintendent, and G. E. Hines is the contractor's chief engineer.

Special Reclamation Advisers' Report Expected Soon

Washington Correspondence

Two-thirds of the final report of the special advisers on reclamation is complete, Governor Campbell, the chairman of the body, announced at the conference with the press on Feb. 8. The full commission has been sitting in Washington since the first of the month. It was stated that on the portion of the report now completed that all are in agreement. The more controverted ponts are not being written into the draft in the hope that agreement may be reached, but it is emphasized that there will be no devitalizing of the report in any effort to secure unanimity. The probabilities seem to favor that there will be certain minority views.

While no portion of the text of the report will be given out by the advisers it was revealed at the press conference that changes in the existing reclamation laws will be recommended. It also was stated that there would be no discussion of the A. P. Davis controversy and no attempt to go into any consideration of the Boulder Canyon project or that of the Columbia basin. It was stated that it is improbable that any testimony will be sought from A. P. Davis although attention was called to the fact that he did not accept an invitation to appear at the Salt Lake City conference with the water users.

The report is to contain no recommendations as to the undertaking of specific new projects, but a formula will be suggested which will make easy the determination of the feasibility of proposed projects. If that formula be applied to existing projects, it will be found, it was suggested, that portions of certain existing projects well may be suspended until economic conditions are more propitious.

There is reason to believe that the report will recommend the resort on all projects to an organization with which each water user will deal rather than continue a direct ward of the federal government.

The advisers expect to be able to place their completed report in the hands of the Secretary of the Interior on March 1.

Pittsburgh County Engineering Department Reorganized

A reorganization of the county engineering forces of Pittsburgh County, Pennsylvania, has been approved, following the recommendations of Norman F. Brown, the new director of public works of the county. Appointments were made as follows: Charles M. Reppert, assistant director; L. F. Bechtel, chief engineer, division of engineering, a position similar to that which Mr. Bechtel has held in the road department but with duties enlarged; W. H. R. Kreling, principal assistant engineer; P. J. Freeman, chief engineer, bureau of tests; W. A. Reppermund, engineer, division of investigation, claims and tests; T. J. Wilkerson, consulting engineer on bridge design; R. H. Helick, engineer, division of maintenance.

N. Y. Power Development Held Up by Deadlock

Lack of Fixed Policy Holds Up Applications for Permits on Four Large Projects

Special Correspondence

In view of the present situation in regard to hydro-electric development in legislative circles at Albany, it is not likely that any power development permit will be granted by the New York State Power Commission this year. Since the present commission took office a year ago it has been its policy to hold up all applications pending action that would fix the state's policy. Applications for permits for four large developments are receiving no action on account of this policy. They are the applications of the St. Lawrence Transmission Co. for a permit to develop a site in the Long Sault Rapids on the St. Lawrence, the application of the Louisville Power Co. involving a site at Croll Island, also on the St. Lawrence, and the application for two companies seeking to develop power on the lower Niagara. These two companies are the Lower Niagara River Power & Water Supply Co. and the Niagara Gorge Power Co.

Under the terms of an agreement reached at a recent conference in Albany, there is a prospect that there may be some non-partisan legislation put through this year along the lines recommended by the Governor in his message suggesting the creation of a state power authority. This power authority will be given the right to issue bonds to raise money for the development of power by the state, but there is little likelihood of any action this year as the proposed legislation will call for an appropriation to make another survey of the power situation in New York State and report to the Legislature in 1925.

STATE-OWNED PROJECTS PROGRESS

In the meantime, nearly two years after the work was authorized, the State Commissioner of Canals has announced that work on the two state-owned power projects at Crescent Dam and Vischer Ferry on the canalized Mohawk River is progressing and that the hydraulic machinery for the plant at Crescent Dam is ready to be installed. At Vischer Ferry the foundations for the power house are finished and the contract for the superstructure has been let. The law authorizing the construction of these two power plants was passed in 1922. At that time the estimated cost of the Crescent Dam project was $1,065,000 and that of the Vischer Ferry plant $1,119,000. These totals, it is said, will be exceeded by perhaps $500,000.

Both plants have an estimated capacity of 8,000 hp. for 60 per cent of the time and machinery for this amount is to be installed, but although there is considerable pondage available for the daily peak load, the continuous output of the plant will be low on account of the fact that a large part of the low flow of the river will be required for canal purposes. For this reason the state will not be able to sell this power at a favorable figure.

Cannon's Reclamation Position Placed Under Civil Service

A competitive examination for the position of Field Reclamation Commissioner is announced by the U. S. Civil Service Commission, open until March 11. The position is that now held by Miles Cannon under appointment by Hubert Work, Secretary of the Interior, after the latter changed the Reclamation Service to the Bureau of Reclamation last June. At that time, Secretary Work having created the new position of Field Commissioner, Cannon was appointed without regard to civil service requirements. An attempt was later made to exempt the position from such requirements, but the Civil Service Commission opposed it. Now Secretary Work has agreed to fill the position after competitive examination to secure an eligible list. He may appoint any one of the highest three on such a list. It is believed that if Mr. Cannon receives a ranking among the three first he will be appointed.

The examination is "unassembled," and comprises submission of the applicant's record of training and experience (rating 70) and a thesis of 2,000 words (rating 30). An oral examination as to personal characteristics may follow.

American Concrete Institute Program Announced

The program for the annual convention of the American Concrete Institute to be held at the Drake Hotel in Chicago, Feb. 25-28, includes the usual technical matter in addition to one day devoted to the history of concrete in honor of the twentieth anniversary of the founding of the society.

Papers to be presented include "Old and New Methods of Constructing Concrete Bridges" by J. B. Hunley of the Big Four Ry.; "New Practice of Iowa State Highway Department for Control of Quality of Concrete" by R. W. Crum, of the Iowa State Highway Commission; "Relation Between Wall Thickness and Diameter of Concrete Culvert Pipe for Highway Use" by G. W. Hutchinson, of the North Carolina State Highway Commission; "The Economic Value of Admixtures" by J. C. Pearson and Frank A. Hitchcock, of the U. S. Bureau of Standards; and "Bending Moments in Columns" by F. E. Richart, of the University of Illinois. There will also be two question box sessions, one on the problems of contractor superintendents and one on concrete products.

Fourth New Jersey City Votes Down City-Manager Plan

Adoption of the city-manager plan of government by Atlantic Highlands, N. J., was defeated at a special election last month. This makes the fourth rejection of the plan in New Jersey since legislation permitting its adoption became effective in the early part of 1923, after several previous failures to secure a state enabling act. The other municipalities to vote down the plan were Deal, Plainfield and Bridgeton. The Atlantic Highlands vote was 351 for to 567 against, a total of 918 votes out of a registration of 1,123.

Random Lines

The Higher the Fewer

"Trade vacuums and labor shortages culminating in a sawed-off demand for building materials, equipment and appliances constitute the sunshine and shade of the 1924 construction markets."
—From an economic forecaster's recent trade report.

* * *

Zoological Note

Harvey W. Corbett, the New York architect, was educated as an engineer, so he knows both breeds. He said last month at the Am. Soc. C. E. meeting that while most architects think engineers are hardboiled eggs, probably most engineers think architects are soft-shelled crabs.

* * *

Unfair Competition

The following letter was addressed to the "Sanitary Engineering Department" of Cornell University:

"Sir: I have been advised that you teach either in your university or your extension department a course leading to the degree of Sanitary Engineer. I am interested in that branch of work and would appreciate any information you can give me relative to your course, where and what books to get and what leaflets and pamphlets to get relative to the course.

"Recently, I have had some correspondence with the Exterminating Engineers of America, Inc., of New York, N. Y., but am not quite satisfied with their proposition. I do not believe one can do the work I am interested in in two or three months. Do you know anything about this institution, its reliability and course of study?"

* * *

In England Too

From London a correspondent sends some circulars issued by Flugel & Co., who seem to make the English equivalent of soda fountains, and who advertise themselves as *carbonating engineers.*

* * *

In this new and efficient era, housewives are known as home engineers. They are content to let father keep his old job as fireman.—*Cleveland Plain Dealer.*

* * *

The Engineer's Compensation

San Luis Obispo, Jan. 25.—As the result of several months controversy in City Council meetings and the delaying for weeks in a stretch of the pay of the City Engineer, the latter, this morning is declared to have given the Mayor two minutes in which to sign his pay warrant, at the end of that time striking the Mayor. A fist fight ensued. Tonight both city officials are nursing black eyes and other scratches. —From the San Francisco *Chronicle.*

Engineering Societies

Calendar

Annual Meetings

AMERICAN CONCRETE INSTITUTE, Detroit, Mich.; Annual Meeting (20th anniversary), Chicago, Ill., Feb. 25-28, 1924.

AMERICAN RAILWAY ENGINEERING ASSOCIATION, Chicago, Ill.; Annual Meeting, Chicago, March 11-13, 1924.

NATIONAL CONFERENCE ON CITY PLANNING, New York City; Sixteenth Conference, Los Angeles, Calif., April 7-10, 1924.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York City; Spring Meeting, Atlanta, Ga., April 9-12, 1924.

AMERICAN ASSOCIATION OF ENGINEERS, Chicago, Ill.; Annual Meeting, San Francisco, Calif., May 12-14, 1924.

NATIONAL FIRE PROTECTION ASSOCIATION, Boston, Mass.; Annual Meeting, Atlantic City, N. J., May 13-15, 1924.

AMERICAN WATER WORKS ASSOCIATION, New York City; Annual Convention, New York City, May 19-24, 1924.

AMERICAN SOCIETY FOR TESTING MATERIALS, Philadelphia, Pa.; Annual Meeting, Atlantic City, N. J., June 23-28, 1924.

The Idaho Chapter of the American Society of Civil Engineers met in Pocatello Jan. 21-22 with about fifty present. Among the addresses was "Recent Irrigation Development and Irrigation Prospects in Idaho" by Warren G. Swendsen, state commissioner of irrigation, President J. H. Wilson outlined the attitude of the national society toward Secretary Work for dismissal of A. P. Davis from the U. S. Reclamation Service. Inspection trips were made to Oregon Short Line tie-treating plant and to American Falls to the plant of the Idaho Power Co.

The Engineers' Society of St. Paul, Minn., at its annual meeting in January elected the following officers; Grover H. Wilsey, president; Clovis M. Converse, vice-president; G. L. Nason, secretary; and G. H. Hutchins, representative on the Minnesota Federation of Architectural and Engineering Societies.

Personal Notes

FRANCIS LEE STUART, consulting engineer, New York, has been employed by the Greater Harbor Committee of 200 of the Los Angeles Chamber of Commerce in connection with the proposed design and development of the port of Los Angeles. Mr. Stuart has been connected with many notable engineering projects. In 1897 he was assistant engineer to the Nicaragua Canal Commission and made the triangulation and hydrographic survey of Lake Nicaragua and the San Juan River. From 1899 to 1900 he served as division engineer for the Isthmian Commission and supervised the plans for the Nicaragua Canal. In 1905 he was appointed chief engineer of the Erie R.R., and later was chief engineer of the Baltimore & Ohio R.R. During the war he served as chairman of the port facilities committee, and he was chairman of the budget committee of the U. S Railroad Administration. Since then among other things he has been consulting engineer of the Hydro-Electric Power Commission of Ontario and engineering expert to the Port Development Commission of Baltimore.

STEVENS & WOOD, INC., construction engineers, New York City, announce that John W. F. Bennett, recently chief construction engineer of the American Sugar Refining Co., has become associated with them as vice-president and contract manager.

FRANCIS J. LAVERTY, formerly junior engineer with the Sanitary District of Chicago, has been appointed assistant engineer with the Division of Sanitary Engineering, State Department of Health, at Charleston, W. Va. Mr. Laverty is a graduate of the sanitary engineering course of Massachusetts Institute of Technology.

JOHN H. NEESON was recently reappointed chief of the Bureau of Highways of the city of Philadelphia. Mr. Neeson had been for seventeen years in municipal service in Philadelphia, first as engineer of the bureau of bridges, and then as assistant engineer in the highways bureau, later becoming chief engineer of that bureau. He is a graduate of the engineering school of Notre Dame University and has held engineering positions with the Reading Ry. and the American Bridge Co.

GERARD H. MATTHES, expert in aerial photographic mapping, who has been retained in a consulting capacity by the Fairchild Aerial Camera Corporation of New York, will assist in developing its aerial mapping department with special reference to the production of maps for engineering purposes. Mr. Matthes recently resigned his position as U. S. Assistant Engineer for the War Department at Chattanooga, Tenn., where for three years he had direct charge of the water power survey of the Tennessee River, in order to devote his entire time to consulting work in aerial photographic mapping. Mr. Matthes will be located in New York.

EARLE W. FASSETT has been appointed city engineer of Casper, Wyo. Mr. Fassett for the past four years was designer and estimator for the Standard Oil Co. of Indiana.

ELROD ENGINEERING CO., general and consulting engineers, Dallas, Texas, has established a branch office in the Mills-Fraser Bldg., Santa Monica, Calif.

Obituary

H. H. BROOK, president and general manager of the Elephant Butte Irrigation District on the Rio Grande project, of the U. S. Reclamation Bureau, died Jan. 5 at Las Cruces, N. M., after a long period of delicate health. Mr. Brook showed remarkable ability in his handling of the affairs of the district, especially in organizing co-operative organizations for the production and marketing of the various products. He was the author of "Difficulties and Complaints of the Farmer," an article which appeared in *Engineering News-Record*, Nov. 29, 1923, as part of the series on Federal Land Reclamation.

JOHN GRAHAM, consulting engineer, Philadelphia, died Feb. 8 at his home in that city, at the age of 71 years. His achievements in railway and municipal work included construction of the New River branch of the Norfolk & Western R.R., reclamation of a large section of Norfolk, Va., and, as consulting engineer, he was interested in the rehabilitation and maintenance of public service corporations. At the time of his death he was acting as receiver for the Chattanooga Street Ry. and Light Co. at Chattanooga, Tenn.

C. R. M. BURROUGHS, supervising engineer for the Central Construction Corporation, in charge of erection of the new Bell Telephone Co. building in Harrisburg, Pa., died in that city Feb. 2 of pneumonia; he was 45 years old. Mr. Burroughs had done construction work for the Thompson-Starrett Co., James Stewart, Inc., and John Gill & Sons, Cleveland.

HENRY W. BRUCE, Dominion government chief assistant engineer of the Welland Canal, died of pneumonia in Allanburg, Ont., Jan. 20 at the age of 43 years. His four years' service on the Welland Canal was preceded by overseas service during the war. He was a native of Ottawa.

WILLIAM A. BOWDEN, for fourteen years chief engineer of the Canadian Department of Railways and Canals, died Feb. 3 at Ottawa, aged 52 years. Mr. Bowden was also Canadian engineering representative on the international board on the project of deepening the St. Lawrence waterway and his most important recent work was the report, in collaboration with Colonel Wooten, on the St. Lawrence question. Among the great works which he designed and superintended as chief engineer of railways and canals were the Hudson Bay Ry., the Trent River improvements, the Prince Edward Island car ferry terminals, the Moncton shops, and the Welland Canal enlargement. Mr. Bowden was a civil engineering graduate of McGill University. He had in earlier years spent some time in the United States specializing in structural steel design with the Riter-Conley Co. of Pittsburgh and other companies.

ALFRED A. BREWER, who has been with Patrick McGovern, Inc., New York City, for the past three years, died Feb. 5 at the age of 57 years. Mr. Brewer during his service with Patrick McGovern, Inc., was engaged on the 14th St. subway in New York City and the Jamaica Bay Boulevard. Previously he was chief engineer of the 14th St. tunnel, the Whitehall St. tunnel, New York City, and the Liberty St. tunnel in Pittsburgh, for Booth & Flinn. His earlier service, with the T. A. Gillespie Co., had included construction of the Walkill siphon of the Catskill aqueduct. Mr. Brewer was a graduate of the University of New Brunswick.

From the Manufacturer's Point of View

A Point of Contact Between Maker and User of Construction Equipment and Materials

Permanent Exhibit Shows Uses of Tractor Power in Engineering and Construction

Wide Range of Applications Indicated by Display of Units Both for Haulage and for Operating Contractors' Standard Equipment

APPLICATION of tractor power in the field of industry, as distinguished from that of agriculture, are demonstrated in the equipment of about eighty manufacturers assembled to form the Ford Power Equipment Exposition, a permanent exhibit occupying 19,000 sq.ft. of floor space in the Ford building at 54th St. and Broadway, New York City. About half of the 150 machines on display are designed for use in civil engineering and construction work.

The equipment shown may be divided into two general groups, one including units whose prime function is haulage, and the other standard types of construction equipment into which the Fordson tractor has been incorporated as the power plant. The first group includes trucks and tractors proper, the latter emphasizing particularly a wide variety of uses in the road-building field. The second group is made up of a wide range of machines, among them being elevating bucket loaders, hoists, road graders and scrapers, concrete mixers, saw rigs, industrial locomotives, road rollers, street sweepers, snow plows and air compressors.

These machines for contractors and engineers occupy two whole floors and a portion of the basement of the building. In addition, an entire floor is given over to small-scale models of plant and equipment by which such raw materials as rubber, steel, glass and wood are converted into the finished products incorporated into Ford cars, trucks and tractors at the River Rouge works. A moving picture exhibit rounds out an understanding of the general scope and the shop methods of the Ford organization.

Function of Exhibit

The primary function of the exposition, as explained by its manager, Guy H. Hall, is educational. The belief is widespread that the Fordson tractor is essentially a tool for the farmer. That it has its place in industry, especially in engineering, construction and municipal work, is the aim of the exhibit to demonstrate in a concrete way and on an impressive scale. Starting about a year ago with only a few machines, the exhibit has been enlarged, month by month, with tractor-operated equipment and truck accessories until today the contractor or the engineer is offered a selection of Ford-powered machinery for an extended range of uses. Of the 150 pieces of equipment on display, the following are of particular interest to contractors, engineers, city and state officials.

There is but one standard model of Fordson tractor. As a preliminary to notes on the combination of this machine with other equipment, the following details of the tractor are given: Its power plant consists of a four-cylinder engine, with a bore of 4 in. and a stroke of 5 in., which is started on gasoline from a 2-qt. tank and subsequently operated with kerosene from a 219-gal. tank. The machine has three speeds forward, 1.48, 2.73 and 6.84 mi. per hour; there is one reverse speed of 2.61 mi. per hour. The weight of the tractor equipped, but without various construction accessories, is 2,770 lb. Its overall length is 102 in.; its overall width, 61⅜ in., and its height, 54¾ in. Both front and rear wheels have steel spokes cast in the hub and riveted to the rim, the rear wheels being equipped with cleats. The power take-off is in the form of a belt pulley operated by a spiral bevel gear from the transmission drive.

Tractor Power Used for—

Hoists — Road Graders — Mixers — Saw Rigs — Snow Plows — Industrial Locos — Loaders — Street Sweepers — Air Compressors — Crawlers

With certain additions or changes to adapt it to special uses, this standard machine is the basis of the various power-operated combinations forming the exposition, as noted below.

Tractor Equipment Combinations

Hoists—The exposition contains four hoisting engines mounted on and combined with the tractor. The Ersted "Hyster," made in six models, is supported at the front end of the tractor on a steel channel extension frame. It is belt driven. The capacity of this outfit is given as 5,000 lb. pull at a hoisting speed of 135 ft. per minute. The Sheffield hoist is equipped with three-speed transmission and driven by a shaft equipped with universal couplings; a rig of this type especially adapted to the setting of telegraph pole was shown. The Clyde hoist, comprising a friction drum 8 in. in diameter, is designed for attachment to the rear end of the tractor without drilling, tapping or machine work of any kind. The attachment weighs 600 lb. and its hoisting duty is given as 3,900 lb. at 42 ft. per minute for the first layer of ½-in. cable. The White hoist, as shown in the accompanying photograph, is built onto the rear axle of the tractor. The tractor-power hoisting rigs were shown both with rubber-tire and cleated metal-wheel mountings.

Road Graders — Road graders and scrapers were represented by four manufacturers. Two of similar type were the Wehr and the Hadfield-Penfield machines with 6-ft. and 8-ft. blades respectively. In these outfits the blade is supported by an arched frame which is pushed rather than pulled by the tractor. The Hadfield-Penfield equipment had rubber-tired wheels on the front end and a crawler tread attachment in place of the rear wheels of the standard tractor. The Wehr machine has rubber tires on all four wheels, the rear ones being of the dual type. Both of these outfits are applicable not only to road grading work but also to snow removal. The Miskin scraper shown is of the wheeled type pulled behind the tractor. The bowl is made in capacities of from ½ to 1¼ yd. The Lessmann auto-dump scraper consists of a ½-yd. scoop mounted on a framework carried at the front end of the tractor with provision for elevating and dumping the load at a height.

Concrete Mixers—Two portable concrete mixers were on display, one, the Mixermobile, on a 1-ton truck, and the other an Archer unit on a Ford car chassis, both equipped with pneumatic tires. The first named machine is a 7-S outfit with chute discharge and power loader; the drum is operated by a chain drive from the truck engine. The Archer mixer is equipped with a hinged platform for hand loading.

Saw Rigs—Saw rigs of both the portable and semi-portable types were shown. The former was a Big Valley rig with table mounted on a frame hinged to the front end of the tractor and equipped with a 30-in. diameter saw. In moving, the frame is merely tilted up and hooked in place; the drive is by belt from the tractor power take-off. The Corley saw-mill was a larger outfit with 12-ft. carriage, 48-ft. track ways, and a 48-in. diameter, 38-tooth inserted saw; it also was operated by belt drive. An American saw-mill completed this section of the exhibit.

Snow Plow—Snow-plow attachments were represented by the Stark V-shaped push plow with adjustable wing spread to cover highway widths of from 8 to 16 ft. The plow itself is made of white oak armored with steel, while the tractor is fitted with rubber-tired wheels equipped with chains to prevent slipping.

Compressor—For compressing air for the operation of rock drills, pavement breakers, tamping tools or calking equipment a Schramm compressor with a capacity of 60 cu.ft. of air per minute was mounted on a two-wheeled rubber-tired trailer attached to a tractor. The tractor engine power was delivered to the compressor by belt drive.

Locomotives—To convert the Fordson tractor into an industrial locomotive flanged wheels have been substituted for the standard running gear by the Brookville Truck & Tractor Co. and

the Adamson Motor Co. The frame of the Brookville unit is of heavy ship channels and the drive is by sprocket and chain. The drive wheels have a 20-in. diameter, and the minimum weight of the unit is 3 tons, which can be increased to 4 tons to secure greater drawbar pull. The drive wheels on the Adamson unit are larger, 33 in. diameter, the weight of the equipment being 3½ tons. A one-piece solid steel frame is used. Both of these industrial locomotive units, it is pointed out, may be converted back again into tractors in a few hours' time. Another Brookville unit utilities the 1-ton Ford truck instead of the tractor. For road rolling and maintenance work the Austin "Pup" roller, equipped with Fordson tractor power, is now fitted with an improved blade, adjustable both as to height of moldboard and width; the outfit weighs 3 tons.

Sweeper — In the Detroit street sweeper and snow brush a 6-ft. cylindrical split bamboo broom is mounted on a steel channel frame in front of the tractor. The broom is rotated by gearing driven by a shaft with universal couplings. Six brush speeds are provided by the transmission. The outfit is mounted on rubber-tired steel disk wheels.

Loaders—Two Fordson-operated elevating bucket loaders were shown at the exposition. The Specialty machine is chain driven, the buckets discharging on an overhanging belt conveyor. The Haiss bucket loader which has previously been described in this journal, has a rated capacity of handling 1 yd. of crushed material per minute.

Trailers—A number of trailers of different types were shown for use with Fordson tractors. Included in the list were several Trailermobile models; a Whitehead & Kales 3-cu.yd. gravity, side-dump body; a Miami 2½-yd. hopper type body with adjustable gate, and an Easton 1½-yd. rollover dump trailer.

Types of Mounting

Special Wheels—Almost any preference for tractor mounting—steel rims, solid or pneumatic rubber tires, half crawlers or full crawlers—can be met by products displayed at the exposition. Whitehead & Kales disk wheels of all sizes and types were shown on much of the equipment. With some of them demountable weights are added to secure greater tractive power. In addition to its rubber-tired equipment, this company also produces flanged wheels for converting the Fordson tractor into an industrial locomotive. The Kelsey Wheel Co. also supplies a wide variety of wheels with weight inserts and extension rims fitted with both long and short cleats. The standard tractor may be converted into a crawler type of machine by substituting for its wheels the continuous treads manufactured by the Full-Crawler Co. To attach these crawlers it is not necessary to drill holes in the tractor or to make up any parts. The wheels are merely taken off, part of the gear control removed, and the full crawler assembled in place using holes already provided in the tractor for this attachment. With this crawler attachment the tractor has a gross weight of 3,600 lb., equivalent to a ground pressure of 3½ to 3¾ lb. per square inch.

Crawlers — Convertibility into a crawler tractor also is offered by the equipment manufactured by the A. B. Johnson Products Co., known as the Trackpull. Large-diameter wheels are fitted with sprocket teeth to drive the crawlers; the treads are of high-carbon steel with crescent-shaped cleats. The length of the track on the ground is 50 in. and since the width of the shoe is 10 in. the total bearing surface is 1,000 sq.in. Dustproof bearings and track rollers are a feature of this equipment.

Truck Bodies

The wide use of the Ford 1-ton truck on road-building and general construction work is reflected in the number of special steel dump bodies displayed for use with this machine. Most of them were of the end-dump type with double-acting tail gate, differing principally in the details of the dumping mechanism. The body manufacturers included Martin-Parry, Griscom-Russell, Heil, Eagle, Wood, Anthony, Jennings and Hughes-Keenan. The Lucius Manufacturing Co. had on display a tank body. Several of the outfits were fitted with York enclosed cabs for winter operation.

To provide the 1-ton truck with a longer wheel-base—142 in.—the Olson extension chassis has been developed to handle a body 10 or 11 ft. long.

Attendance at Exposition

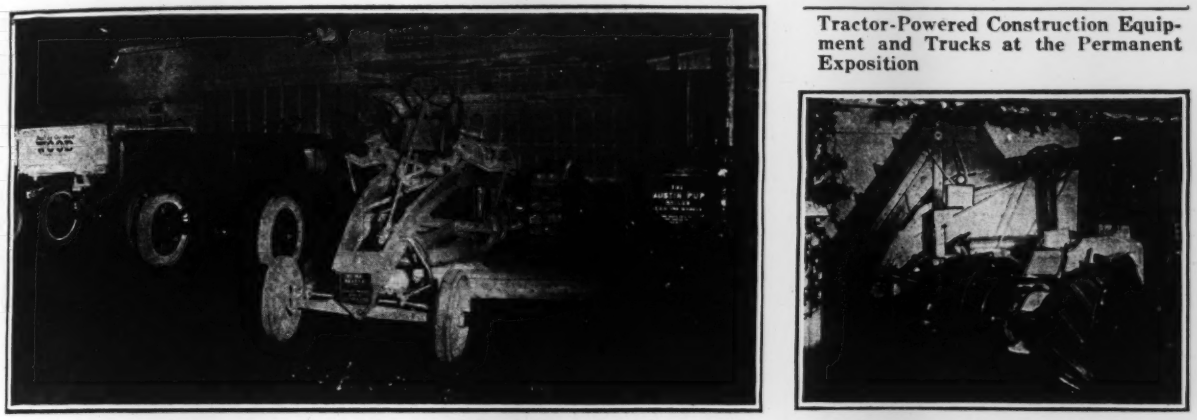
Attendance at the Ford Power Equipment Exposition, Mr. Hall reports, has been gaining steadily during recent months until the daily average now runs between 1,500 and 2,000. A large percentage of these visitors are contractors engaged in highway work, building, or general construction; engineers, and city officials. The exposition also furnishes a means of educating Ford dealers in expanding their business by more intelligent sales efforts in the tractor and truck field. During January, when the New York Automobile Show was in progress, 65,000 persons passed through the Ford building, according to the count of Mr. Hall's staff.

A Centralized Market

In carrying out the purpose of the exposition to provide a centralized market of industrial equipment built around the Fordson tractor and the Ford 1-ton truck, a staff of trained assistants is on the exhibition floors at all times to answer questions. Registration cards are filled in by those visitors whose inquiries indicate sales possibilities. In the case of construction equipment combined with the Fordson tractor, these inquiries are referred both to the construction equipment manufacturer and to the Ford dealer nearest the home of the prospective purchaser.

It is the belief of Gaston Plaintiff, Eastern division manager of the Ford Motor Co., and chairman of the exposition, and Guy H. Hall, exposition manager, that industrial work forms one of the largest fields for the Fordson. "While tractors have been acknowledged leaders in agricultural usage," said Mr. Hall, "the construction industry is now disclosing great possibilities for the employment of the tractor both as a hauling unit and as a power plant in combination with standard forms of construction equipment. It is the only tractor in the world with such a wide range of equipment especially designed for use with it."

Tractor-Powered Construction Equipment and Trucks at the Permanent Exposition



From Left to Right: End Dump Truck Bodies; Blade Grader; Road Roller and Maintainer; Elevating Bucket Conveyor; Hoisting Engine

Steel Reinforcement Firms Merged in Large Company

Kalman Steel Co. Purchases Corrugated Bar Co.—Capitalization Announced As About $2,000,000

The Kalman Steel Co., Chicago, has purchased the Corrugated Bar Co., Buffalo. By this amalgamation the Kalman Co. is believed to be the largest distributor of reinforcing steel bars in the United States. The combined companies will be operated under the name of the Kalman Steel Co. with a capital of approximately $2,000,000. The plants of the Corrugated Bar Co. have been taken over and necessary reorganization looking to actual operation of the combined companies is to be accomplished within the next month.

The Corrugated Bar Co. was organized in 1892. Its plants are located at Buffalo, Hammond, Ind., Boston, Philadelphia, and Atlanta. The Kalman Steel Co. since 1901 has been a distributor of reinforcing steel and related products. Its plants are located at Chicago, New York, Youngstown, St. Paul, and Minneapolis.

The executive personnel of the enlarged company is as follows:

President, Paul J. Kalman, who has headed the Kalman Steel Company since its inception. Mr. Kalman is also president of Bliss & Laughlin, Inc., of Harvey, Ill., cold drawn steel; president of the Hudson Motor Co. of Illinois; chairman of the board of directors of the Globe Steel Tubes Co., Milwaukee; and president of the Kalman Floor Co.

Vice-President and general manager, George E. Routh, Jr., who, with Mr. Kalman, founded the Kalman company. Mr. Routh is vice-president of the Kalman Floor Co. also president of the Titchener-Diehl Co., Chicago, manufacturer of wire shapes.

Assistant vice-president, J. A. Cathcart; treasurer, A. E. Pinard; general manager of sales, A. P. Clark who has for many years been general manager of sales for the Corrugated Bar Co.; chief engineer, W. S. Thomson, former chief engineer of the Corrugated Bar Co.; Eastern sales manager, L. O. Helgeson, with headquarters at New York.

The executive offices of the amalgamated companies are at 22 West Monroe St., Chicago, but will be moved before April 1 to the Wrigley Building, Chicago.

District sales offices are established in the following cities: Chicago, New York, Philadelphia, Boston, Atlanta, Buffalo, Detroit, Cleveland, St. Louis, Kansas City, St. Paul, Minneapolis, Pittsburgh, Milwaukee, Dayton, Syracuse, Hartford, Conn. and Danville, Va.

Water Works Exhibit Committee Named

The Water Works Manufacturers Association has just announced the appointment of its Exhibit Committee for the forty-fourth annual convention of the American Water Works Association to be held at the Hotel Astor, New York, N. Y., May 19-23. The committee is headed by J. E. O'Leary, of the Pittsburgh-Des Moines Steel Co., chairman, and includes two other members, J. D. Capron, U. S. Cast Iron Pipe & Foundry Co., and Charles M. Reed, Central Foundry Co.

Business Notes

RANSOME CONCRETE MACHINERY CO., Dunellen, N. J., has completed a new concrete and structural steel building with a ground area of 320x64 ft., which will add 50 per cent to the manufacturing floor space of the plant. Equipped with two 5-ton traveling cranes, shears, punch-presses and riveting machines, the new structure will house all structural and plate work, while the old building will be employed for machine work. Other improvements include the acquisition of a field for testing the traction of Ransome pavers under their own power and a stand for testing the drum mechanism of mixers.

PALMER STEEL CO., Springfield, Mass., announces the opening of an office at 2 High St., Albany, N. Y., in charge of C W. Post, sales engineer, formerly with the Eastern Bridge & Structural Co.

SOUTHERN PINE ASSOCIATION comprising leading lumber manufacturers in 10 Southern States, will hold its ninth annual meeting at the Hotel Roosevelt in New Orleans March 11 and 12. On March 10, the day preceding the opening of the subscribers' convention, there will be a session of the board of directors of the association and various committee and special meetings to consider particular phases of the association's activities and problems affecting the Southern pine industry.

COL. WALTER J. RILEY, president of the O. F. Jordan Co., East Chicago, Ind., manufacturer of the Jordan spreader, has left for his annual winter travel trip. This time he goes around the world. Besides being head of the Jordan company Col. Riley is president of a group of banks and trust companies and is also chairman of the Interstate Harbor Commission, made up of representatives of the United States, Indiana and Illinois.

DONALD B. MACNEAL has established a business as dealer in contractors', railroad and industrial equipment at 166 West Jackson Blvd., Chicago, specializing in locomotive cranes. He was formerly connected with McArthur Bros. Co., contractors, and for the past four years was manager for A. C. Tarbert, Chicago, dealer in contractors' equipment.

ENGLISH BROTHERS MACHINERY CO., Kansas City, Mo., is the new name under which the former English Tool & Supply Co. has been re-incorporated. There are no changes in administrative personnel, C. C. English continuing as president and treasurer, James J. Moran as vice-president, and T. F. English as secretary. The new name was chosen to indicate better the character of the company's business.

BEAR TRACTORS, INC., New York, has expanded its sales organization by the following appointments: H. A. Reed, general sales manager and R. C. Brewsaugh assistant sales manager and advertising manager, with headquarters in New York; C. A. Bishop, district sales manager, with headquarters in Kansas City; Harvey E. Sewell, district sales manager, with headquarters in Philadelphia; Pablo Homs, export manager, with headquarters in New York.

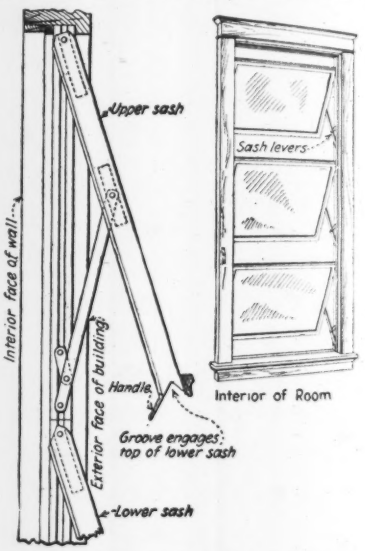
READING IRON CO., Reading, Pa., is completing a new charcoal iron plant with an annual capacity of 30,000 tons.

BLAW-KNOX CO., Pittsburgh, has made arrangements with A. W. Malone to market the Malone anchors for transmission towers.

Equipment and Materials

Window Sash of Transom Type

In the horizontally pivoted window sash of the Kawneer-Simplex type, as made by the Kawneer Mfg. Co., Niles, Mich., and Chicago, each window is fitted with one, two or three sashes



like transoms, pivoted in the side frames and operated by levers. This arrangement is designed to give ample ventilation without causing drafts and without admitting rain; the amount of opening can be regulated to suit requirements, a practically unobstructed opening being given with the sash in horizontal position.

No weights, cords or pulleys are employed and as the sash is reversible both sides of the glass can be washed from the inside of the room. Shades, screens and weather strips can be applied. In most cases the sash frames swing outward, beyond the exterior face of the wall of the building, but in some cases they are arranged to swing inward, the pivots being then placed at the bottom instead of at the top of the sash. Vertically-pivoted casement sash is made also. The above type of horizontally-pivoted sash has been used more extensively for schools, but also for hospitals, garages, stores, office buildings and residences.

Business Side of Construction

FACTS AND EVENTS THAT AFFECT COST AND VOLUME

January Iron and Steel Output Gained—Production of Other Basic Materials Slower

Iron—Over 3,000,000 tons of pig iron were produced in furnaces throughout the country during January, against approximately 2,900,000, in December, 1923. This represents a gain of slightly more than 97,000 tons. The average daily output for January was 97,384 tons, compared with 94,225, during December; this gain being the first increase reported since May, 1923, at which time iron production began to decline.

Steel—The January steel ingot output increased 3 per cent over that of the preceding month, but represented a drop of over 14 per cent compared with the record total of 4,000,695 tons for May, 1923. The January total was 3,432,541 tons and that of December, 2,711,529 tons, according to the American Iron and Steel Institute. Production by months for the last year is given in tons as follows:

January, 1923	3,644,629
February	3,294,264
March	3,858,675
April	3,760,997
May	4,000,695
June	3,574,567
July	3,350,829
August	3,506,755
September	3,173,801
October	3,382,986
November	2,969,012
December	2,711,529
Total for 1923	41,228,739
January, 1924	3,432,541

Lumber—The lumber movement for the entire country for the four weeks ended Jan. 26, 1924, is marked by a slight decline in production; an increase in shipments and an unusually heavy jump in demand, compared with the four weeks ended Dec. 29, 1923. Compared with a year ago, however, there is a slightly lessened demand and fewer shipments, and a slight increase in the amount of lumber cut. Orders and shipments are 110 per cent of normal production; the output, however, is 5 per cent below normal, according to the National Lumber Manufacturers' Association.

Brick—There were fewer burned brick on hand Jan. 1, 1924, than on Dec. 1, 1923, according to the Common Brick Manufacturers' Association of America. Demand also dropped slightly during that period. The common brick industry is seasonally dull at this time of the year. Remarkably few plants, however, are closed down. Every manufacturer who possibly can, is running full blast. On Dec. 1, 1923, over 28 per cent of all plants were closed down, against 25 per cent on Jan. 1, 1924.

Cement—Following the usual seasonal trend of cement production, the total output for January, 1924 is placed by the Geological Survey at 8,788,000 bbl.; shipments at 5,210,000 bbl. and stocks on hand, Feb. 1, at mills throughout the country, 14,153,000 bbl. This represents a drop of 12 per cent in production and 19 per cent in shipments and a gain of 33⅓ per cent in stocks on hand, compared with the month preceding. During March, however, the reserve mill stocks will begin to shrink rapidly, if the trend observed in previous years is followed.

Reports received by *Engineering News-Record* from eight important centers, taken in a zig-zag line across the continent, show construction materials to be plentiful both at mills and in the dealers' warehouses.

A few exceptions, however, appear in the form of a slight shortage of sewer pipe in Los Angeles, Denver, and Chicago and scarcity in sizes above 24-in. in New York; small stocks of paving brick and hollow tile in Detroit and a demand for yellow pine greatly in excess of production in New Orleans.

Construction, Labor and Living Costs All Mounting Higher

That building trades wages did not keep up with the cost of living between the years 1915 and 1920 is graphically illustrated in the accompanying chart. Since 1920, however, the average wage rate for building mechanics has been higher than the cost of living, in fact, between the first quarter of 1921 and the last quarter of 1923 the wage level was higher than that of either the cost of living or the cost of construction.

In the chart the construction cost element is represented by the *Engineering News-Record* Construction Cost Index Number; the wage rate and the cost of living factors by index numbers prepared by the Bureau of Labor Statistics, U. S. Dept. of Labor. The three index numbers are based on 1913 as 100.

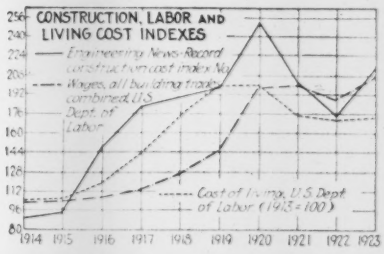
Union wage rates obtain so generally in the building trade that a composite figure for all crafts is here accepted as representative of building wages. These rates, however, are available only as of May each year.

The cost of living index includes family expenditures for food, clothing, housing, fuel, light and miscellaneous items. These figures are as of December. The *E. N.-R.* Construction Cost Index Number is the average of the twelve months.

The three curves followed the same general trend from 1913 to the 1920 peak. Between 1920 and 1921, however, when construction and living costs both declined rapidly, the wage trend continued upward.

Between 1921 and 1922 the general trend was down. Beginning with 1922 and continuing until the close of 1923 the trend in all three indexes has been consistently upward, with construction cost showing the strongest upward tendency of the three.

Labor and construction costs are now well above the 1919 levels and are moving toward the dangerously high schedule of 1920.



El Salvador Sanitation Contract Awarded to New York Firm

The successful flotation of the Government of the Republic of El Salvador loan in New York toward the end of 1923, makes possible the execution of the contract celebrated in 1922 between the Government of El Salvador and Messrs. R. W. Hebard & Co., Inc. of New York and Panama and Rene Keilhauer, for the general sanitation of the capital city, San Salvador.

The work comprised in the contract covers water works, sewerage, and paving.

San Salvador, the largest city of Central America, lies at an elevation of 1,000 meters above the sea and has a population of 125,000 people. It is connected by railway with the Pacific ports of Acajutla and La Union.

The city is located in the earthquake zone of Central America and the problem of the contractors, who also act as engineers for the work, is not dissimilar to that now confronting the Japanese government in the design and construction of a sewerage and water system which will be undisturbed by seismic shocks.

The plan of the municipal improvements covers a three year period and the works are estimated to cost $3,000,000.

French Cast-Iron Pipe Used By Pasadena Water Department

That foreign cast-iron pipe has entered the American market is revealed in the recent letting of a contract covering 48,000 ft. of c.-i. pipe for the Water Department of the city of Pasadena, Calif.

The contract covers 12,000 ft. of 4-in. (100 mm.); 16,000 ft. of 6-in. (150 mm.); 16,000 ft. of 8-in. (200 mm.) and 4,000 ft. of 12-in. (300 mm.) pipe, weighing approximately 1,000 tons, valued at $50,788, including fittings, which price was at least $6,000 under that of any of the American makers who offered bids.

This pipe is now on ships enroute

from France; two carloads purchased on a separate order having been received by the Water Department and found to be in excellent condition.

The material was purchased under the City of Paris specifications and is made in 4-meter lengths. It is lighter in weight than the American Water-Works Association's specifications for Class B pipe and the tensile strength exceeds that required by the association.

The pipe was purchased at a substantial saving in price to the city of Pasadena and earlier delivery was offered than that stated by the American companies.

Bids Wanted on Big Jobs

Among the projects on which bids are either asked or will soon be called for, in Construction News, pp. 85 to 96, are the following:

Grading and surfacing, Little Rock, Ark., Pulaski Co., 95 mi. roads, $3,000,000.

Plant, Toledo, O., Libbey-Owens Sheet Glass Co., $1,000,000-$1,500,000.

Seminary, St. Louis, Mo., Missouri Evangelical Synod, $2,000,000.

Apartment, New York, N. Y., One Hundred Fifteen East 48th St. Corp., $3,500,000.

Office, San Francisco, Calif., Pacific Telephone & Telegraph Co., $3,500,000.

Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

Valuable suggestions on costs of work can be had by noting actual biddings as reported in our Construction News section.

The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of Feb. 7; the next, on Mar. 6.

Steel Products:	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Structural shapes, 100 lb.	$3.64	$4.00	$4.40	$3.30	$3.55	$4.20	$3.60	$3.85	$4.25
Structural rivets, 100 lb.	4.40	4.75	4.90	3.75	4.00	—5.1	5.00	4.05	6.00
Reinforcing bars, ¾ in. up, 100 lb.	3.54	3.50	3.38	3.20	3.45	3.85	3.65	4.25	—3.90
Steel pipe, black, 2½ to 6 in. lap, discount	44%	53.2%	43%	47%	53–5%	36%	37.10@47.40%	45%	47.43
Cast-iron pipe, 6 in. and over, ton	61.60@63.60	56.00	61.00	57.20@60.20	61.50	67.00	59.00	62.00	60.00
Concreting Material:									
Cement without bags, bbl.	2.50@2.60	2.35	2.05	2.20	2.42	2.84	2.61	2.90	+2.72
Gravel, ¾ in., cu.yd.	2.00	2.00	+2.38	2.00	1.85	1.90	2.15	1.50	1.50
Sand, cu.yd.	1.25	1.42	2.00	2.00	1.25@1.50	1.00	1.50	1.50	1.25
Crushed stone, ¾ in., cu.yd.	+1.85	2.00	2.83	2.00	2.00	3.50	2.15	3.00	1.90
Miscellaneous:									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft.	61.00	40.00	54.75	+58.00	43.75@45.00	41.75	36.00	29.00	65.00
Lime, finishing, hydrated, ton	18.20	22.50	20.00	20.00	25.50	24.00	22.00	24.00	21.00
Lime common, lump, per bbl.	3.00@3.25	1.65	1.85	1.50	1.50	2.70	2.10	2.80	9.50
Common brick, delivered, 1,000	23.65@25.85	12.00	11.60	11.00	16@18	12.00	15.50	15.00	+17.50
Hollow building tile, 4x12x12, per block	Not used	.10	.11	—.064	.075	.065	.....	.11	.115
Hollow partition tile 4x12x12, per block	.1179	.10	.11	.....	.....	.065	.108	.11	.....
Linseed oil, raw, 5 bbl. lots, gal.	.95	+1.01	+1.10	.94	+1.05	+1.15	1.03	1.15	—1.18
Common Labor:									
Common labor, union, hour	.75	+.35	.....	.....	.....	.50@.55	.55	.62½	.....
Common labor, non-union, hour	....	+.30	.30@.50	.82½	.40@.45	.35@.50	.50	.62½	—25

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or — signs. For steel pipe, the prevailing discount from list price is given; 45-5% means a discount of 45 and 5 per cent.

New York quotations delivered, except sand, gravel and crushed stone, alongside dock; common lump lime, in 280-lb. bbl. net, and hydrated lime f.o.b. cars; tile "on trucks"; linseed oil and cast-iron pipe f.o.b.

Labor—Concrete laborers' rate, 93½c.; building laborers (pick and shovel men) 75c. per hr.

Chicago quotes hydrated lime in 50-lb. bags; common lump lime per 180-lb. net. Lumber delivered on job.

Minneapolis quotes on fir instead of pine. Brick, sand and hollow tile delivered. Cement on cars. Gravel and crushed stone quoted at pit. We quote on brown lime per 180-lb. net; white is $1.80 for Kelly Island and $1.70 for Sheboygan. Common labor not organized.

Denver quotes on fir instead of pine. Cement "on tracks"; gravel and sand at pit; stone on cars; lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered, in iron bbl. Common lump lime per 180-lb. net.

Atlanta quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net.

Dallas quotes lime per 180-lb. bbl. Steel, cement, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered.

San Francisco quotes on Heath tile, size 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to dealers in yards at San Francisco, for No. 1 fir, common.

Seattle quotes on Douglas fir (delivered) instead of pine. Lump finishing lime per 180-lb. net. Hollow building tile delivered. Hydrated lime in paper sacks. Sand and gravel at bunkers.

Montreal quotes on Douglas fir instead of pine. Sand, stone, gravel and lump lime per ton. Cement, lime and tile are delivered; sand, gravel and stone on siding; brick f.o.b. plant; steel and pipe at warehouse. Hollow tile per ft. Cement price is in Canadian funds (the Canadian dollar stands at 97.02.) Bag charge is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment. Steel pipe per 100 ft. net; 3-in., $47.43; 6-in. $119.

Weekly Review of the Market

The outstanding feature of the current market situation is the recent increase in pig iron production. This favorable change in the great trade barometer, the first in eight months, not only indicates a stronger demand for the ferrous metal products, but also points to possibilities of a similar upward trend in most of the other basic materials.

Reserve materials' stocks have been adequate to meet the mid-winter demand, especially since purchasing has been confined mostly to immediate needs. Next month, however, buying for spring construction will necessitate greatly increased production schedules.

Brick prices remain firm throughout the country, while pine lumber shows a steady increase in demand with rising prices. Lumber cutting has been retarded by unfavorable weather conditions and reserve stocks are low.

The iron and steel situation, in brief, follows: Heavy pig-iron inquiries still pervade market; much foreign iron being used; minimum on No. 2 foundry iron $23 per ton at Birmingham, against $22, recently; steel plate demand confined mostly to small tonnages; railroads and ship builders taking bulk of output. Plates are quoted at $2.40@$2.50 per 100 lb., Pittsburgh; as low as $2.30, however, has been heard. Structurals are more active than plates, the mill base price holding generally at $2.50 per 100 lb., with some reports of shading to $2.40. Bars firm at $2.40.

The general tendency of cement prices is toward firmness. In eleven out of fifteen centers, however, present prices are below those of a year ago. Prices to contractors, in carload lots, f.o.b., without bags, are given in the following representative cities:

	Feb. 4, 1924 Per bbl.	Feb. 7, 1923 Per bbl.
Cedar Rapids, Iowa	$2.40	$2.48
Chicago, Ill.	2.20	2.20
Cincinnati, Ohio	2.37	2.54
Cleveland, Ohio	2.41	2.46
Davenport, Iowa	2.29	2.43
Detroit, Mich.	2.37	2.47
Duluth, Minn.	2.19	2.14
Indianapolis, Ind.	2.31	2.41
Milwaukee, Wis.	2.35	2.37
Minneapolis, Minn.	2.42	2.39
Peoria, Ill.	2.27	2.41
Pittsburgh, Pa.	2.19	2.24
St. Paul, Minn.	2.42	2.39
Toledo, Ohio	2.40	2.48
Buffington (mill Ind.	1.95	1.80